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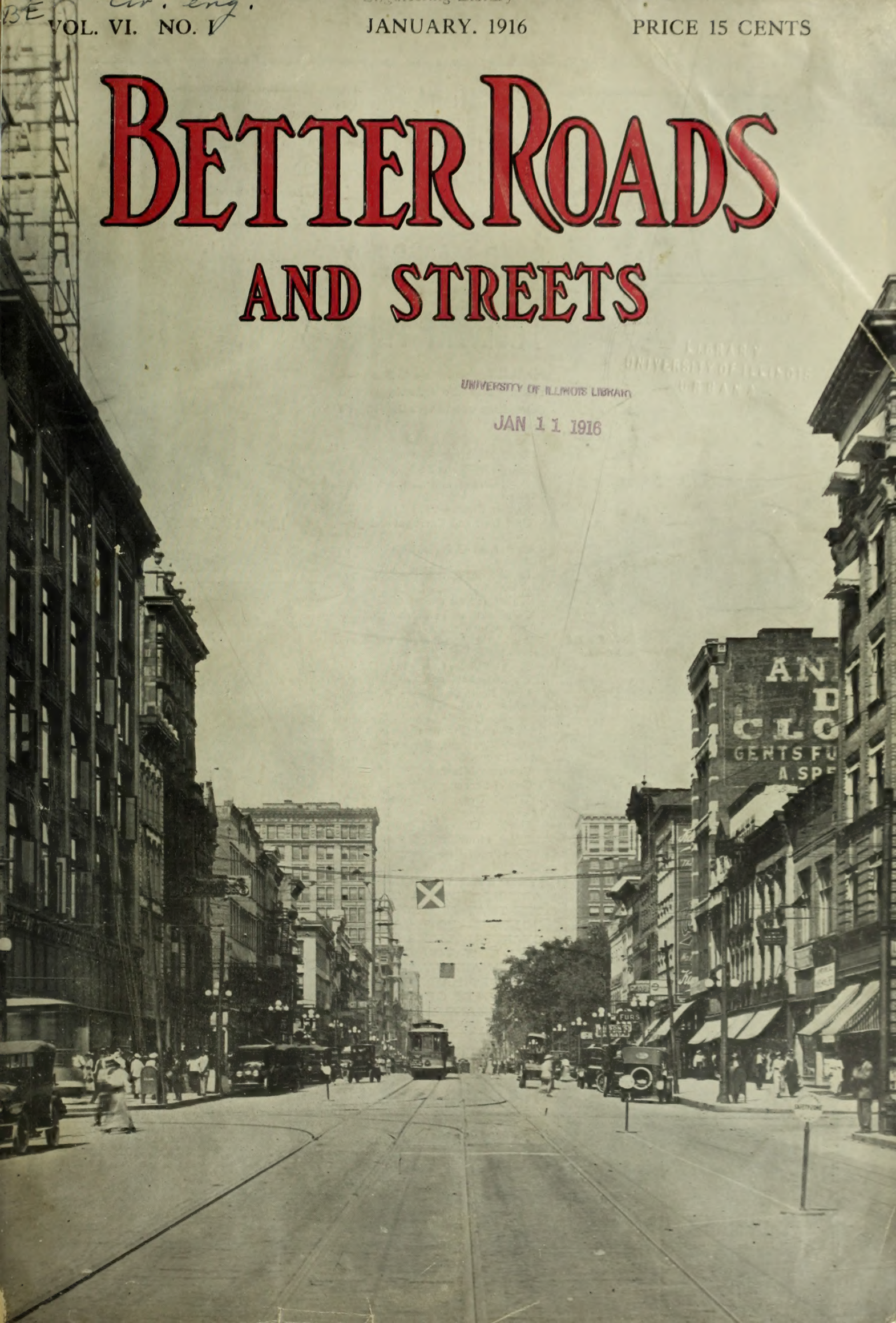
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VOL. VI. NO. V JANUARY. 1916 PRICE 15 CENTS

# BETTER ROADS AND STREETS

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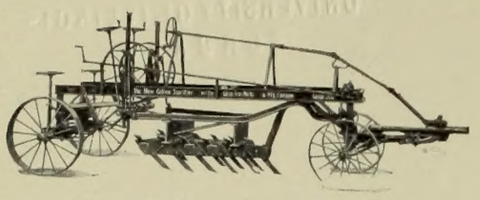




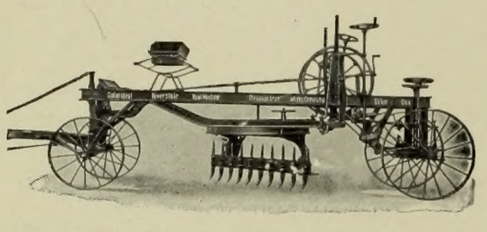
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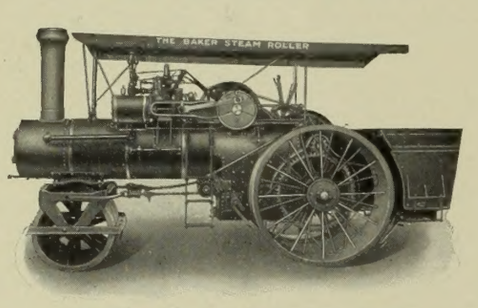
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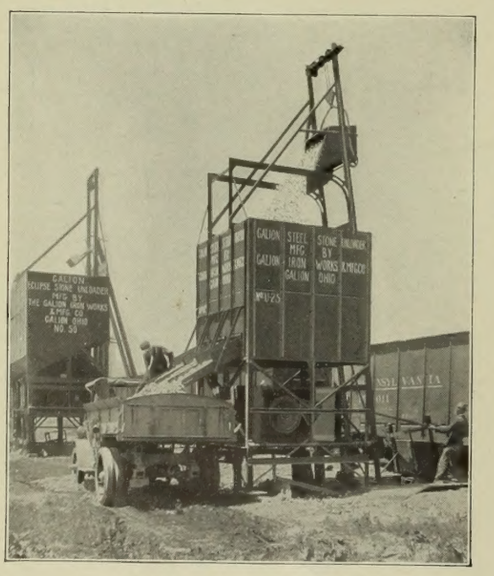
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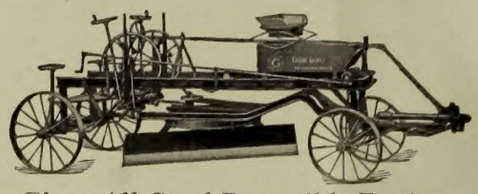
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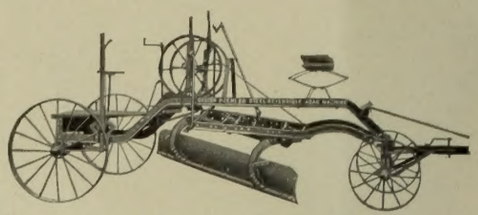
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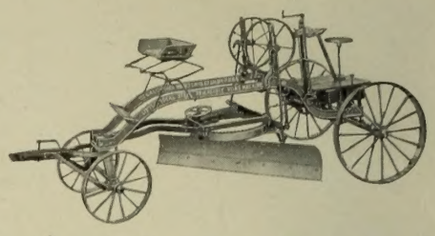
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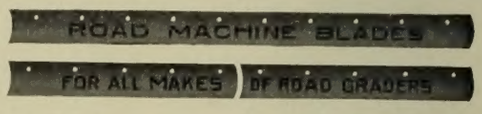
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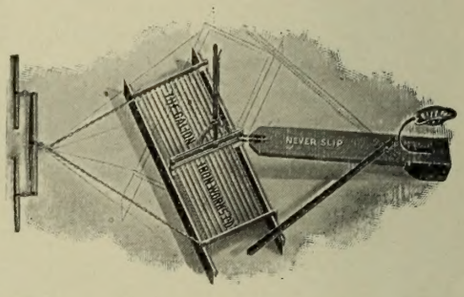
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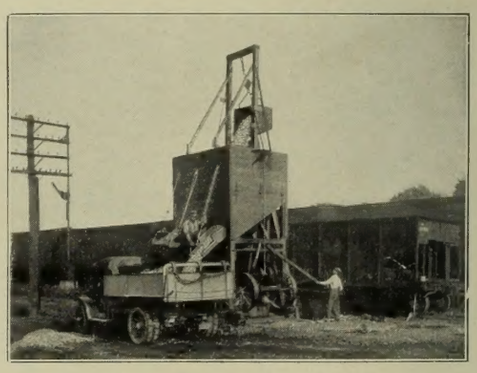
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# Better Roads and Streets

VOL. VI. NO. 1 JANUARY, 1916 PRICE FIFTEEN CENTS


## Work of the Pennsylvania State Highway Department in 1915

By Robert J. Cunningham, Commissioner

ONE of the reasons Governor Martin G. Brumbaugh gave for appointing me State Highway Commissioner of Pennsylvania was that he knew that I was neither an engineer nor a road builder. The Governor stated that he had already appointed a chief engineer of the State Highway Department who he felt certain was fully qualified to supervise all of the engineering work that was necessary. His prophecy has been realized to the fullest extent. Mr. W. D. Uhler, Chief Engineer of the State Highway Department, has made good. In addition, the First Deputy Commissioner, Mr. Joseph W. Hunter, is an engineer of many years' experience, and has been connected with the Pennsylvania State Highway Department since it was formed. Mr. George H. Biles, at the time he was appointed, was the engineer in charge of the Maintenance Division of the Department, and shortly afterwards, Governor Brumbaugh advanced him to the Second Deputy Commissionership, thus consolidating the work of the Engineer of Maintenance and that of the Second Deputy Commissioner, and effecting a saving of an annual salary of four thousand dollars.

In addition to the above engineer-officials, the Department has fifteen assistant, or Division Engineers, each of whom has under his personal supervision from 750 to 1,050 miles of State Highways. Therefore, Governor Brumbaugh evidently had in mind that it was for the good of the Department to have some one represent the people of the State, rather than an engineer, resulting in my appointment.

This article is prepared, therefore, from the viewpoint that I am the representative of the people interested in good roads rather than as a technical Commissioner of Highways of the State of Pennsylvania.

Those who travel over the highways of Pennsylvania are not interested in the difficulties and technicalities that confront the engineer and the road builder. What they expect and demand are good results. They are, and always have been willing to pay the price, but in return, our people insist upon at least a measure of efficiency.

Engineers may differ as to the proper method of procedure in the construction of a brick highway, an asphaltic concrete highway, or a concrete or a macadam road. The traveling public, however, cares little for the views of the engineers, but they do expect to have a good road, warranted by and fully equal to the amount of money expended to procure the same. The success of the Highway Department is assured if it depends solely upon the ability of its engineers, for we all feel that the engineers now connected with the Department are the best obtainable.

The chief duty of the Pennsylvania State Highway Commissioner, as it appears to me, was, under the re-organization incident to the present administration, to put in force a well-defined business policy that would work in harmony with the amount of money available. As a result, efficiency and maintenance were adopted as being productive of the best results that the public could expect, until such time as money could be appropriated which would enable the Department to enter actively upon the construction of the State Highway System as defined by the Sproul Act of 1911 and its supplement of 1913.

Co-operation from any and every source was sought, and we are glad to be able to say that we have had the best assistance possible from the Auditor General, the Forestry and Health Departments, the Public Service, and Water Supply Commissioners, and all other departments of the State Government, the work and interests of all of which, to a greater or less extent, are intermingled with the work and interests of my department. But if there has been any one source of co-operation that was more beneficial to the State Highway Department than any other, it was the hearty co-operation that has been given the Department by our Governor, who, as is well known in every section of the State, is one of the staunchest and most active advocates of the good roads movement, a movement with which every one is more or less in sympathy.

One of the main objects in view in calling together the forces of the various State departments, as was explained by Governor Brumbaugh in his address at the Third Pennsylvania Welfare, Efficiency, and Engineering Conference at Harrisburg in November, was what he termed a "Get Together Movement", as he believed that greater efficiency in the government of State affairs could be effected if the department heads understood the workings of the different branches of the State government.

This certainly is a good business proposition, as the State Highway Department has experienced several times a lapping-over of work that has been, and is done by other departments. This, had we been in closer touch with each other, could have been avoided, and would have resulted in the saving of many thousands of dollars. I have in mind the map survey as made by the State Highway Department. This work has been under way for several years, and to date, there has been expended in the preparation of maps and surveys by the State Highways Department, the sum of $381,923. The State Geological Commissioner, in conjunction with the United States Government, has now in preparation surveys and maps that could just as well have been prepared at the same time as were the highway surveys, and with but very little additional expense. Several months ago, the State Highway Department undertook the work in conjunction with the Commission and the United States Government, but, after comparing notes, found that more than seventy-five per cent. of the highway work had been completed and that the remainder that was to be done included counties that the Topographical Commission had already completed, so that at this late day there can be no effective co-operation in this work.

Early in the administration of the affairs of the Pennsylvania State Highway Department, we realized the benefits that could be derived from a "Get Together Movement" in our own department, in consequence of which the Division Engineers have been called into the department offices at Harrisburg on two different occasions so that they might obtain the views and policies of the Department, and also that they might come in closer touch with each other's work. The engineers were also all called in to attend the Third Pennsylvania Welfare, Efficiency and Engineering Conference, during which the Department held meetings at least twice each day.

The system of roads that comes directly under the control and supervision of the Pennsylvania State Highway Department comprises more than 10,200 miles, a much larger mileage than that included in the system of any other State in the Union. New York State, which is now expending the proceeds of its second $50,000,000 bond issue, has but a little more than one-half of the mileage that we have in Pennsylvania. New Jersey has about one-fifth. Maryland has about one-ninth, and Massachusetts has less than one-tenth of the road mileage to maintain that we are called upon to look after in Pennsylvania, and yet sufficient money has not been placed at the disposal of the Pennsylvania State Highway Department to enable it to undertake any new construction.

The policy of the Pennsylvania State Highway Department, and this policy has the approval of our Governor, is that we maintain, so far as possible, all the roads taken over by the State under the Sproul Act. This year we have improved 1,880 miles of stone and hard surfaced roads, 557 miles of flint, gravel and shale roads and 5,824 miles of earth roads, making a total of 8,262 miles of roads that have been put in first-class condition. Of this improvement, 450 miles was resurfacing work on roads which had already been constructed. The average cost of this resurfacing work was approximately $2,500 per mile.

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Many miles of guard rails have been placed at dangerous points; numerous culverts and small bridges have been constructed; 1,050 miles of stone, flint, and shale roads have been oiled and treated. The policy of applying light oils, or an asphaltic oil on the stone roads has been adopted for two reasons. The first is that it enables us to better hold the stone on the road, and the second that to a great extent it allays the dust, which is a general nuisance, not only to the traveling public but also to those living along our highways.

A distinctive feature that marks most of the State highways in Pennsylvania has been the policy this year of whitewashing the guard rails, fences, trees, poles, and other permanent structures along the highways.

But little new construction has been undertaken this year other than State-aid construction. Contracts have been let and the work of improvement is now going on on five miles of roadway between Huntingdon and Mill Creek, and about four miles are being built through Chester County, with the expectation of connecting up all the gaps on this route in Delaware and Chester counties, and extending to the Maryland State line, a total distance of about eighteen miles. We were enabled to undertake this latter improvement owing to the fact that good roads enthusiasts in those counties solicited and secured funds amounting to over $70,000 to assist in the improvement of this important connection.

The State Legislature gave the State Highway Department the sum of $8,300,000 for the years 1915 and 1916. This, it was prescribed, should be expended as follows:

For maintenance and construction, $6,000,000, or $3,000,000 for 1915 and a like amount for 1916.

$1,500,000 to be used for the partial payment of the indebtedness of the State to the township supervisors.

$500,000 to be applied on State-aid work in connection with the counties, boroughs and townships.

$250,000 for freeing of toll roads included in the State Highway System, and a special appropriation of $50,000 for the National, or Cumberland Pike.

This $3,000,000 which we had for maintenance and construction in 1915, and which we will also have in 1916, dwindles into comparative insignificance when divided by the 10,000 miles of highways in our system, leaving less than $300 per mile.

Had it not been that the State Highway Department received the moneys from automobile licenses from January 1 to June 1, 1915, amounting to approximately $1,400,000 in addition to the $3,000,000, we would not have had money to resurface and construct the roads that we did in 1915. It is not generally understood by the people of the State, but it is a fact, nevertheless, that from the first of June, 1915, until the next Legislature convenes, the State Highway Department does not receive in addition to its appropriation, the receipts from the automobile licenses issued. For 1916, we will receive a straight appropriation of $3,000,000, and of this amount the Department will collect about $2,000,000 from the sale of automobile license plates, but which we will have to turn into the treasury of the State, so that the Commonwealth of Pennsylvania is actually only appropriating $1,000,000 for the maintenance of its highway system.

We have inaugurated the system of patrolmen along the important highways of the State Highway System, and up to the present writing, we have at different points throughout the State, 195 men whose sole duty is to keep the side ditches open and to properly maintain the five or six miles of roadway that has been allotted to each of them. By this means we hope and fully expect to materially lessen the maintenance cost on our improved highways.

One of the important bureaus in connection with the Pennsylvania State Highway Department is the Bureau of Township Highways. This Bureau has not, perhaps, received the attention that it should have received, and we expect during the year 1916 to place it, with its engineers and their experience, more freely at the disposal of the fifteen hundred boards of township supervisors. The township supervisors, in addition to the $1,500,000 appropriated to them by the State, collect annually from the tax-payers about $5,500,000, all of which is expended in constructing, repairing, and maintaining the roads of the State. These township supervisors have full charge of the maintenance and repair of more than 80,000 miles of roads, and with the total money received by them, about $7,000,000, and by the proper co-operation of the Bureau of Township Highways, we are certain that a marked improvement will be made in the condition of many thousands of miles of these township roads.

State-aid construction, for which the last Legislature appropriated the sum of $500,000, is done on the basis of the State Highway Department supervising the work and paying fifty per centum of the cost of the improvement. The balance is paid in to the State by the township, county, or borough making application for the improvement, so that there is actually $1,000,000 to be expended for this class of work. If the improvement is on a State Highway Route, the maintenance is paid by the State, which assumes full control of the road after the improvement is once made. If the improvement is on other than a State Highway Route, however, the maintenance is taken care of by the township or borough, whichever the case may be.

In conclusion, I will say that the policy of the Pennsylvania State Highway Department is to give all of its transactions the widest publicity. We have nothing to conceal, either in the awarding of contracts, the maintenance of our highways or in the materials that are used by the Department in any of its work, whether it be construction, reconstruction, repair, or maintenance work. In fact, there is nothing to be concealed in connection with this administration and the expenditure of the State's appropriation, and it is our desire and intention to keep the residents of the State, and the public in general, fully informed as to what the Department is doing.

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## A Sweeping Change in the Engineering Force of the State Highway Department

### Announced December 20th by State Highway Commissioner Cunningham who Approved the Reorganization Plan made by Chief Engineer W. D. Uhler

The State has been re-districted and an additional engineering district created. Two employees of the Department have been promoted to become Acting Assistant Engineers in charge of districts and one has been transferred to take the place of the engineer of construction who has been acting as assistant engineer.

Four new county superintendents have been appointed and several have been named to succeed others who have resigned or who have been removed.

In announcing these changes, State Highway Commissioner Cunningham and Chief Engineer Uhler declared that all of the new positions have been filled by promotion based on the merit system. Every man advanced has been with the State Highway Department for several years, and has demonstrated his ability to hold his position.

The First Engineering District, formerly composed of Centre, Clearfield, Clinton, and Indiana counties, has been changed to comprise Centre, Clinton, Mifflin, and Huntingdon counties. The headquarters of this district had been in Clearfield but have now been transferred to Bellefonte. W. D. Meyers remains as Assistant Engineer in charge of this District. W. O. Bennett is Superintendent of Centre County and C. H. Orndorf, who has been a draftsman attached to District Number 2, at Harrisburg, has been promoted to be Superintendent of Clinton County. · D. A. McCloskey, who has been Acting Chief of Construction in District Number 11, has been promoted to Superintendent of Huntingdon County, taking the place of T. J. Strickler, resigned.

In District Number 2, headquarters at Harrisburg, formerly comprising Dauphin, Perry, Lebanon, Mifflin, and Juniata counties, Mufflin County has been cut out and Snyder County replaces it. The Assistant Engineer in charge is C. W. Hardt who remains, and the superintendents are unchanged.

In District Number 3, with headquarters at Bloomsburg, A. S. Clay remains as Assistant Engineer in charge. Snyder County has been added to District Number 2 and Sullivan County has been taken over to District Number 3 in its place. The county superintendents remain as before except that W. R. Mason, is transferred to be under Mr. Clay instead of under the Assistant Engineer in charge of the district of which Sullivan County was formerly a part.

(*Continued on page* 55.)

# State Highway Officials Demand One Convention

Your Committee appointed for the purpose of preparing resolutions and making recommendations upon the holding of National Road Congresses offers the following report, that

WHEREAS, the attending of the many road congresses has become a serious question with State Highway officials not only in the time consumed and in the interference with official duty, but also in the matter of expense, and

WHEREAS, The maintenance of two Associations of National scope working independently and without harmony is a detriment to the good roads movement. Therefore be it

RESOLVED, That the members of this Association oppose the holding of any National Road Congress prior to December 1, 1916, and do hereby bind ourselves not to attend or participate in any manner in any National Road Congress held prior to that date. Be it further

RESOLVED, That we urge the executives of our respective States not to appoint any delegates to represent the said several States in case any National Road Congress is held prior to said date. Be it further

RESOLVED, That it is the sense of this Association that for the good of the road movement the American Road Builders Association and the American Highway Association should amalgamate into one organization, or that they should at least arrange to hold jointly one annual road congress. Should they fail to arrange prior to August 1, 1916, for such a joint congress to be held in December, 1916, or early in 1917, then the Executive Committee of this Association is authorized to designate the date and place of our next meeting, and notify the above Associations of the same, requesting them to hold a joint meeting at that time and place.

FURTHER, That if the said Association shall amalgamate or make a harmonious arrangement for an annual joint congress to be held as above suggested, we hereby pledge the hearty support and co-operation of this Association, and, be it further

RESOLVED, That the Secretary of this organization forward to each State Highway Department of the several States not represented at this meeting, also to the Engineering Department or Board of Public Works in all cities of the United States having a population in excess of 100,000 and also to all manufacturers of road machinery, materials, and supplies, a copy of these resolutions, asking for their approval and co-operation in carrying out the same. Be it further

RESOLVED, That a copy of these resolutions be forwarded to the Secretary of the American Road Builders Association and to the American Highway Association. Be it further

RESOLVED, That the vote upon the adoption of these resolutions be by roll call of the States here represented and that said vote shall become a part of these resolutions.

Respectfully submitted,
S. E. BRADT, Illinois.
GEO. P. COLEMAN, Virginia.
A. R. HIRST, Wisconsin.
Committee.

Such was the resolution adopted with but one dissenting vote by the American Association of State Highway officials at their annual meeting held at Chicago, December 7 and 8, 1915.

Prior to the appointment of the committee to draw up the resolution, the whole matter was thoroughly thrashed out in executive session. The vote, however, was taken in open session; the discussion was brief, and no amendments were offered. Every one appeared to have his mind fully made up; there was no doubt about how each member felt on the question, and it was evident that the feeling was a deep-rooted one.

This action was directly in accord with a previous resolution adopted at the organization meeting of the association held in Washington D. C. a year ago but, because of the developments of the past twelve months, this year's resolution was couched in more emphatic terms.

### PROPOSED FEDERAL AID BILL.

Second only in importance to the matter of road conventions was the reconsideration of the propsed Federal Aid Road Bill drawn up by the executive committee and adopted by the association at their session in Oakland, California, on September 11, 1915. The bill is given herewith:

## AN ACT.

TO PROVIDE THAT THE UNITED STATES SHALL AID THE STATES IN THE CONSTRUCTION OF RURAL POST ROADS.

*Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled,* That in order to promote the improvement of Rural Post Roads, Military Roads and roads used for inter-State commerce, the Secretary of Agriculture is authorized to co-operate with the State Highway Department of each State in the improvement of such roads, acting for this purpose through the Office of Public Roads, or some other official designated by him.

SEC. 2. That the Secretary of Agriculture, after making deductions hereinafter provided for, shall apportion the appropriations made under the provisions of this Act for each fiscal year, among the several States, in the following manner:

One-third in the ratio which the area of each State bears to the total area of all the States; one-third in the ratio which the population of each State bears to the total population of all the States, as shown by the latest available Federal census; one-third in the ratio which the mileage of Rural Post Roads of each State bears to the total mileage of Rural Post Roads in all the States, as shown by the latest available report by the postmaster general.

SEC. 3. That for the purpose of carrying out the provisions of this Act, there is hereby appropriated out of any moneys in the treasury, not otherwise appropriated, for the fiscal year ending June 30, 19—, the sum of $25,000,000 and for each of the fiscal years 19— and 19— the sum of $25,000,000. So much of the appropriation apportioned to any State for any fiscal year as remains unexpended at the close thereof shall be available for expenditure until the close of the succeeding fiscal year, except that amounts apportioned in any fiscal year to any State which has no highway department or other department enpowered to act as such shall be available for expenditure in that State until the close of the third succeeding fiscal year after the close of the fiscal year for which such apportionment is made.

Provided, that any amounts appropriated and apportioned under the provisions of this Act remaining unexpended under the terms of this section shall be re-apportioned to all the States in the same manner, and on the same basis as the original appropriations under this Act.

SEC. 4. That so much of the appropriation made under the provisions of this Act as the Secretary of Agriculture may estimate to be necessary, not to exceed five per cent., shall be deducted by him at the beginning of each fiscal year for administering the provisions of this Act, and any portion of such amount unexpended at the close of any fiscal year shall be made a part of the appropriation for the succeeding fiscal year and re-apportioned according to this Act. Within sixty days after the final passage of this Act and thereafter on or before January 20 next preceding the commencement of the fiscal year, he shall certify to the Secretary of the Treasury and to the State Highway Departments the sum which he has designated to be deducted for administering the provisions of this Act, and the sum which he has apportioned to each State for such fiscal year. All payments under this Act shall be made by the Secretary of the Treasury on warrants drawn by the Secretary of Agriculture to the party or parties designated by the State Highway Department as the fiscal agent of the State or county authorized by law on the part of the State or county to receive said funds.

SEC. 5. Any State Highway Department may petition the Secretary of Agriculture for aid in the improvement or maintenance, under this Act, of any Rural Post Road, Military Road, or road used for the promotion of inter-State commerce, except on streets of cities, towns or boroughs having a population in excess of 2,000 inhabitants, but such aid may be had on streets and roads in said municipalities when the houses average more than 200 feet apart. The term "Rural Post Road" as used in this Act shall be deemed to mean any public road over which the United States mails are or may be transported. If the Secretary of Agriculture approves said petition, then the State Highway Department shall make, or cause to be made, such surveys, plans, specifications, and estimates, as the Secretary of Agriculture may require; provided, further, that said plans and estimates and specifications may be for roads of soil or sand-clay construction, as well as for other approved types of roads, which surveys, plans, specifications and estimates shall be submitted to the Secretary of Agriculture for approval; and if the plans and estimates meet the approval of the Secretary of Agriculture, he shall notify the Secretary of the Treasury to set aside a share of the estimated cost of such improvement, which, including the cost of engineering, shall not exceed fifty per cent., and in no case to ex-

ceed $10,000 per mile exclusive of bridges of more than twenty feet clear span, and the said Secretary of Agriculture shall authorize the said State Highway Department to advertise for bids for all of the work according to the laws of the State, or do the work as otherwise provided for by the laws of said State. No payments of any money appropriated under this Act shall be made on account of such road until it shall have been made to appear to the satisfaction of the Secretary of Agriculture that a sum not less than the amount appropriated by the said Secretary of Agriculture out of the funds apportioned under this Act and petitioned for in connection with such road shall have been made available for expenditure by or on behalf of such State for the improvement of such road.

SEC. 6. All road work in the several States done under the provisions of this Act shall be under the direct supervision of the respective State Highway Departments, subject to the inspection of the Secretary of Agriculture and such rules and regulations as may be agreed on by and between the said Highway Departments and the Secretary of Agriculture. The Secretary of the Treasury shall pay upon warrants to be drawn by the Secretary of Agriculture the portion of the cost of such improvement or maintenance payable under this Act by the Federal Government. Such payments shall be made from time to time upon estimates made by the State Highway Department and approved by the Secretary of Agriculture, or his designated representative. The final cost of the work shall include a reasonable expense for engineering, inspection and unforeseen contingencies, not to exceed ten per cent., of the total cost of the work.

SEC. 7. The term "Highway Department" as used in this Act shall be held to mean any legally constituted State Highway Department, or other department of the State Government authorized by law, to act as a Highway Department for that State.

SEC. 8. The Secretary of Agriculture is authorized to withhold and re-apportion funds from any State in which roads improved under the provisions of this Act have not, in his judgment, been properly maintained, if, within six months after notice in writing has been given by him to the said State authorities, they fail to maintain or repair said roads previously improved under the provisions of this Act.

SEC. 9. The Secretary of Agriculture is authorized to decline to issue warrants under this Act for failure on the part of any State to comply with the provisions of this Act, or upon breach of agreement made with him pursuant to this Act. If any payment be so withheld, the Secretary of Agriculture shall certify the reasons therefor to the Secretary of the Treasury and to the Governor of the State before the close of the fiscal year in which such payment is withheld, and shall report his action to the next regular session of Congress. If the conditions upon which such action by the Secretary of Agriculture is based are not remedied within ninety days after the date of said certificate, it shall be added to the amount to be apportioned among the States for the next ensuing fiscal year.

SEC. 10. That, out of the appropriation provided by this Act, the Secretary of Agriculture is authorized to employ such assistants, clerks, and other persons, in the city of Washington and elsewhere, to rent such buildings in the city of Washington and elsewhere, to purchase such supplies, material, equipment, office fixtures and apparatus, and to incur such travel and other expenses as he may deem necessary for carrying out the purpose of this Act.

SEC. 11. That necessary bridges and culverts shall be deemed to be a part of the respective roads covered by the provisions of this Act.

SEC. 12. That the Secretary of Agriculture is authorized to make rules and regulations for carrying out the provisions of this Act.

SEC. 13. That this Act shall be in force from the date of its final passage.

In executive session the association discussed the bill thoroughly, section by section. No changes were made except that, when the bill is presented to Congress, it is proposed to have the amount of the appropriation striken out, leaving the latter to the regular house or Senate committee on appropriations. In other words, the bill will be offered as an organic act without appropriation and, if passed, Congress may vote each year, whatever amount of money it deems advisable to carry on the work. This will avoid any misconceptions regarding the motives of the members of the association who, like practically all other citizens familiar with the road situation, are agreed that federal aid is a vital necessity, but are willing to leave the matter of *how much* aid, to those responsible for all government finance.

### TECHNICAL PAPERS.

The remainder of the convention program had to do largely with papers and discussions on the engineering features of road construction and administration. The meeting place was at the LaSalle Hotel, Chicago, and the first session was called to order by President Shirley at ten a.m., Thursday, December 7, 1915.

The first business consisted of reports by the president and secretary in which the work of the year was summarized. It was the opinion that much had been accomplished, largely through bringing the various highway departments into close co-operation, providing an opportunity for the commissioners and engineers from all of the States to meet each other in an informal manner and talk over the problems common to all. An especial advantage is the possibility of holding executive sessions where failures as well as successes can be freely discussed to the mutual advantage of all concerned.

The first paper on the program was entitled, "Surface Treatment of Gravel, Sand-clay and Macadam Roads," by E. A. Stevens, State Road Commissioner of New Jersey. Col. Stevens told, in a comprehensive way, of the experiments which had been conducted in New Jersey with calcium chloride, lignins (Glutrin and similar materials), asphaltic oils and tars, and the results obtained with each under varying conditions. Discussion was taken up by H. G. Shirley, W. D. Uhler, and Joseph Hyde Pratt, with the result that some very definite conclusions were arrived at.

The afternoon session was called to order with Thomas H. McDonald, of Iowa, presiding. The first paper presented was by A. D. Williams, Chief Road Engineer, of West Virginia, on the subject, "Metal Pipe in Road Work." Being in the nature of a preliminary report, no specifications were presented nor any definate conclusions drawn by the association. The committee is still at work and considering all suggestions.

Following this paper, the meeting was turned into an executive session when the subject of road congresses and the Federal Aid Road Bill, as outlined above, were discussed.

### THE "DUTCH LUNCH."

No sessions were held in the evening which was devoted to a "Dutch Lunch." Mr. Pratt announced that the only thing "Dutch" about it was that every one had to pay for his own ticket. We do not know exactly what was meant by this but, in any event, the dinner was excellent as were the talks which followed.

"Bill" Edens, President of the Associated Roads Organizations of Chicago and Cook County, acted as toastmaster and in his characteristic and happy style, welcomed the visitors to Chicago in the name of all the many organizations in which he is a leading spirit.

Robert W. Dunn, attorney for the Associated Roads Organizations was the first speaker and outlined the history and accomplishments of that active body which is made up of committees from the various associations and clubs in Chicago and Cook County, devoting time and funds to civic work.

Following Mr. Dunn, A. D. Gash, President of the Illinois State Highway Commission, told of the State highway work now under way in Illinois and of the difficulties encountered in teaching the rural inhabitants—particularly the more wealthy and influential farmers, strange as it may seem—the need of good roads.

Col. Stevens, of New Jersey, was the next to be called upon, and discussed another difficulty hampering the building of good roads. The thought is well expressed in a few words by Mr. Stevens: "The common, prevailing fallacy is that any one who has ever made a success in any line of human endeavor is fully qualified to build roads."

Talks by Chief Engineer A. R. Hirst, of Wisconsin, and Chief Road Engineer A. D. Williams, of West Virginia, on

(*Continued on page* 57.)

# Public Road Improvement in Canada

Consul G. R. Taggart, Cornwall, Ontario, October 14

MUCH interest is being shown hereabouts, especially by farmers and automobilists, in the forthcoming modern stone highway, to cost $600,000, from Ottawa, Canada, south 60 miles to the international St. Lawrence River boundary.

This road will, it is said, be built as a memorial to the late Hon. J. P. Whitney, Premier of Ontario. Mr. Whitney was from 1882 to 1890 (when this consulate was a commercial agency with headquarters at Morrisburg, Ontario) American vice commercial agent.

As in the United States, the question of Federal aid in the construction of "metalled" (stone, gravel, slag, etc.) roads often arises, but so far the Government at Ottawa has no direct connection with highway improvement. Analogous, however, to State-aid in road improvement, the Ontario provincial government at Toronto is now authorized by recent legislation, not only to advise and direct the construction and maintenance of permanent highways, but also to contribute toward the cost.

### WHAT THE PROVINCE OF ONTARIO IS DOING.

A Department of Highways has been created at Toronto (effective January 1, 1916), with a deputy minister in charge under the Minister of Public Works and Highways, providing for the appointment of an office force, engineers, etc. The Government program aims at benefiting three classes of roads, namely, township roads, county or market roads, and long stretches of main highways.

For township roads the provincial aid consists, not in helping to pay for the construction, but in encouragement and advice toward efficient township organization. The main part of the such township encouragement is the payment by the Province of 25 per cent. of the salary for three years of a township road overseer up to $600 per year.

County or market roads consist of a system of roads meant to accommodate the greater part of the market travel in the country. The provincial government grants toward a county road system are 40 per cent. of the cost of construction (said grant not to exceed $4,000 a mile) and 20 per cent. of the cost of maintenance. The balance of the cost of construction comes from the proceeds of bonds or of taxation. Roads must be built in accordance with the regulations of the Ontario Department of Public Highways. The construction of such a system of county roads may be authorized by two-thirds majority of a county council (called in the United States, sometimes, county commissioners, or board of chosen freeholders), representing at least one-half of the equalized assessment of the county; or, failing to receive a two-thirds majority of the county council, said county road construction may be carried by a simple majority of the county council, and confirmed by a majority vote of the taxpayers.

### MAIN HIGHWAYS.

A still longer system of improved highways would consist of roads running through more than one county. Such a system may be properly called main highways. Toward the construction and maintenance of main highways the same assistance (40 per cent. and 20 per cent.) may be (when the legislation becomes effective on January 1, 1916) granted by the provincial government. The balance of the construction cost and the maintenance cost are assessed on the various municipalities served by the highway. A start may be made on main highway construction by a petition of three-fourths of the municipalities interested. When, in the opinion of the Ontario lieutenant governor in council, it is in the public interest to build such a main highway a board of trustees of five members are appointed. The board may require a report on the proposed work, with plans, specifications, and estimates, and said board may proceed with the work, making such revision of the estimates as may be necessary after hearing representations from all parties interested.

County or main highways thus aided by the Province are popularly called "Government roads." A main highway would naturally include along its route any improved county roads, or might be made up, of course, of a series of such county roads.

### LEGISLATION AUTHORITY—ACTION OF THE COUNTIES.

The legislative authority for the above-stated provisions is as follows: Act for the improvement of public highways, R. S. O., 1914, chapter 40; amendment to this act entitled "An act to amend the highway improvement act," 5 Geo. V, chapter 16; the Ontario highways acts, 5 Geo. V, chapter 17; the statute law amendment act, 5 Geo. V, 1915, sec. 29.

All this legislation is now in force except the act relating to main highways (the Ontario highways act, 1915, 5 Geo. V, chapter 17), and this exception will, it is officially announced, be proclaimed by the Ontario lieutenant governor in council on January 1, 1916.

Although 20 out of the 38 counties of Ontario have, with provincial help, developed efficient systems of county roads, these chances of provincial aid in road betterment have not as yet (except perhaps through the acceptance of encouragement in the townships) been taken advantage of in this consular district, nor, indeed, in the three counties (Dundas, Stormont, and Glengarry), of which Cornwall is the county seat. Consequently, the roads in this district are far from first class.

In Dundas County, however, Morrisburg, the western limit of this district, is bidding for the opportunity of being the southern terminus of the above-mentioned Whitney Memorial Road from Ottawa to the St. Lawrence River.

### A NEW INTERNATIONAL HIGHWAY.

Beginning with preliminary surveys, the Ottawa-St. Lawrence Government road will doubtless be started in the spring of 1916 unless the unsettling of all conditions by the war prevents. Like the Meridian highway from Winnipeg, Manitoba, to the United States, this eastern road is intended to accommodate not only the farm traffic of the adjacent country, but also automobile travel entering Ottawa from within Canada and from the United States. Once the St. Lawrence international boundary bordering on New York State is tied to Ottawa by a modern stone road, there will be (in view of the links of good roads throughout the length of New York State) good road connection between New York City, the metropolis of the United States, and Ottawa, the capital of Canada.

Authority for the construction of this Ottawa-St. Lawrence road would come from the above-mentioned Ontario highways act (5 Geo. V, chapter 17), when proclaimed on January 1 next. The construction and maintenance will be in charge of a commission or board of trustees to be appointed by the Ontario lieutenant governor in council. The road allowance will not be less than 66 feet wide. The roadway between ditches would be approximately 28 feet wide, with a central metaled (stone, slag, etc.) driveway of from 10 to 16 feet in width. There are as yet no specifications nor is the type of road decided upon. In general features, however, the highway will correspond with the standard set by first-class New York State roads.

### COST OF CONSTRUCTION—ALTERNATIVE ROUTES.

The anticipated cost of construction of this Ottawa-St. Lawrence good road is $10,000 a mile, or about $600,000. Both the construction and the upkeep cost will be assessed on Ottawa and on the municipalities through which the road passes. The Province would contribute toward the cost about $4,000 a mile, or $240,000. Since Ottawa would benefit from the road out of proportion to the other municipalities, a larger sum than is required by the statute is proposed for Ottawa's quota, namely, $180,000. The balance, or another $180,000, would be assessed on the townships through which the road passes. To meet the immediate expenditure for the construction or maintenance of the road, the commission or board of trustees may issue bonds or debentures, which obligations may be guaranteed by the Province of Ontario.

Two alternative roads are proposed for this Government main road, both through strictly agricultural communities—

(*Continued on page* 58.)

# Public Co-operation in Highway Work

By A. P. Irwin

EDITORIAL NOTE.—We present herewith a short abstract of an excellent address made by Mr. A. P. Irvin, of Chadd's Ford Junction, Pennsylvania, before the Third Pennsylvania Welfare, Efficiency, and Engineering Congress at Harrisburg, Pennsylvania, on November 18. Mr. Irwin is one of the most enthusiastic road boosters in the State of Pennsylvania, and was selected to speak on the above topic because of his wide personal experience along the lines of the subject of his talk. Mr. Irwin is also the man who personally secured the sum of $70,000 from a large number of personal friends and interested citizens in Chester and Delaware counties which he turned over to the Pennsylvania State Highway Department to aid in the reconstruction of the Old Baltimore Pike, one of the most important highways in the State. This road was in miserable shape, but there was no money available which the State Highway Department could use in this reconstruction work. Mr. Irwin made a substantial contribution himself, and went around among his friends in the counties through which the road runs, personally securing the above sum. He then went to State Highway Commissioner Cunningham and offered this large sum of money to the Department, the only provision being that the Department would at once start the reconstruction of the road, adding whatever State money was available to that donated. The Commissioner accepted this proposition, and reconstruction of this famous old road, the most important route between Philadelphia and Baltimore and Washington, was started. It is public-spirited co-operation of this kind that Mr. Irwin firmly believes is a benefit to the State and to the residents thereof. The following abstract of an address by such a man will, therefore, be of more than ordinary interest to those interested and identified with every phase of road work.

In opening his address, Mr. Irwin stated that he was going to speak from the standpoint of the business man who has trade interests extending all over the country, and that he believed that in the judgment of those best qualified to express an opinion, the period of criticism of the Pennsylvania State Highway Department, so bitter under former administrations, had been passed, and that the better basis of co-operation had already been established. He stated that the problems of construction and maintenance of the highways in any State are of sufficient importance to challenge the thought and interest of the citizens, and that particularly in Pennsylvania with her vast highway system of more than 10,200 miles of highways in various stages of disintegration, the State Highway Commissioner and his Chief Engineer must, at all times, have the sympathy and active co-operation of all the citizens if they are to have any great measure of success. He declared that Pennsylvania is particularly fortunate in that the State Highway Commissioner enjoys the first requisite of success, which is the confidence of the people. He further stated that Mr. Cunningham's success so far in Pennsylvania has been due, not only to his own wide experience and business-like methods, but also to the experience and co-operation of his Chief Engineer, Mr. W. D. Uhler, whose work, Mr. Irwin said, has attracted the attention of road builders all over the country, and whose methods are now being copied and carried out in other States, as the method employed this year has without question given the greatest results for the smallest expenditure of money. Continuing, Mr. Irwin said:

"Next to the public schools in any commonwealth, there is nothing so important for the general welfare as good roads. They enter into the life of every man, woman, and child, and have a far-reaching effect and influence. To the man they bring quicker transportation, resulting in a consequent saving in time and money and greater opportunity to get around and mingle with his fellow men. This gives him new and possibly better ideas for carrying on his business or his profession. To the women and children they make possible the chance to meet the neighbors socially and thereby receive more from life and to enjoy it to the fullest extent; the ability to occupy a higher position in life and to become a factor of usefulness in their locality, and the opportunity to attend school more regularly, thus securing a finer education. The improvement of the roads of this, or any other State, therefore appeals strongly to the mothers, girls, and boys just as much as to the men.

"The greatest power in bringing about this co-operation between the people and the State Highway Department is the press of the State. It has done splendid work in moulding public opinion, and in creating a sentiment favorable to the improvement, repair, and maintenance of the roads, and to the wise expenditure of money to bring this about. This can be increased by keeping in touch with all the newspapers in the State, taking them into your confidence, and giving them as many interesting and authentic news items as possible, thereby letting the public at large know just what is being done and giving them the opportunity to study all phases of road building, road repair, and road maintenance, together with the methods that are being employed for the financing of the improvements."

The automobile, Mr. Irwin stated, is also a valuable ally in promoting co-operation with the State Highway Department. He cited the valuable services that have been rendered in the State by automobile clubs to stimulate the good roads movement, and forcibly called attention to the fact that the automobilists of the United States are paying annually more than $13,000,000 to the several States in the form of registration fees, drivers' licenses, etc., a large portion of which, in every part of the country, is being used in the maintenance and reconstruction of our roads.

Referring again particularly to Pennsylvania, Mr. Irwin said that a bond issue is the only practical way of financing our highway system, where there are so many hundreds of miles of roads which should be reconstructed. He laid great stress upon the progress that other States have made through being able to construct their road systems out of the proceeds of the sale of bond issues, and said that Pennsylvania, which is the richest State in the United States, cannot lag behind her sister States in road development and improvement. It will, he said, pay the State to expend the necessary amount of money for the construction of the proper types of roads in the system, as this money will come back with compound interest to the citizens who will be able to increase production on account of the lower transportation charges which will be made possible by the smooth, hard roads. And the money that would be received as the result of a bond issue, he said, could easily be spent under such conditions that every dollar of it will be used to the best advantage, and the people of the State could rest assured that it would all go into the roads and road structures. But, he said, this could only be done in one way, and that way is to take the State Highway Department out of politics. Then continue the Department with the present State Highway Commissioner and the present Chief Engineer in charge, not for a term of two or three years, but indefinitely, so that they could only be removed for cause or by resignation. Give these two officials trained men in every department and pay them the same salaries that they could receive from any of our large corporations for similar services. The qualifications of these men should simply be fitness and ability to do the work required, and to demonstrate this by actual results.

"Remember," said Mr. Irwin, "This is a big business involving the expenditure of many millions of dollars. Therefore, why not run it on a business basis? The employees of any large corporation are the greatest asset of such a corporation. They can make it a success, and if they do not do their part, their services are soon dispensed with. Therefore, under the same conditions, the State Highway Department of Pennsylvania would be a phenomenal success, and would easily set the pace for every other State in the Union to follow."

Mr. Irwin then cited the spirit of co-operation which has already been shown in certain parts of Pennsylvania by the citizens and taxpayers, where roads were badly in need of improvement, but where the money for such improvement was not available from the State Highway Department. He called attention to the most notable example of this kind, which is the Old Baltimore Pike, and explained what has been done this past year by reconstructing this historic thoroughfare so that it is now a modern and well-constructed highway. He also told of the generous aid that has been rendered the State Highway Department by wealthy and influential citizens of Lehigh and Northampton counties, where a model concrete road is being built, and is now half completed, connecting Easton, Allentown, and Bethlehem. In this case, the cement, coarse and fine aggregates and the freight were all donated by the citizens of the community, and the actual construction and engineering work was done by the State Highway Department.

In conclusion, Mr. Irwin said:

"The question of having good roads is largely a matter of education, for while the State Highway Department will ultimately pave all of the main roads of the State between the large centers of population, it will be necessary for the boroughs and townships to look after the roads within their respective borders, and soon they will have demands from the people for

(*Continued on page 60.*)

# First Traffic Census of the Central Business District of Chicago

THE results of the first complete traffic census ever taken in Chicago have recently been published in pamphlet form. Prior to the taking of this census, which was done during last July and August, no effort had been made by the city to secure a fully tabulated count of all vehicles passing given points of observation, though at various times in past years, a census of all vehicles had been taken, merely to ascertain the total number passing per hour.

There were two objects in taking the present detailed census:

1. To find out the effect of traffic on street cleaning.
2. To ascertain the density and kind of traffic for use when a type of pavement is to be selected to pave any particular street.

The estimated tonnage for each class of vehicle was the same as that adopted by the Bureau of Highways, Brooklyn, New York, namely:

| | |
|---|---|
| Large auto trucks, loaded | 8 tons |
| Large auto trucks, empty | 4 tons |
| Small auto trucks, loaded | 3 tons |
| Small auto trucks, empty | 1½ tons |
| Automobiles | 1¾ tons |
| Wagons and carriages | 1½ tons |
| Iron Tired Vehicles— | |
| Three-horse trucks, loaded | 7½ tons |
| Three-horse trucks, empty | 3½ tons |
| Two-horse wagons, loaded | 4 tons |
| Two-horse wagons, empty | 2 tons |
| One-horse wagons, loaded | 2 tons |
| One-horse wagons, empty | 1 ton |

The forms used in the census, with some minor additions, were recommended by the American Society of Engineers. A sample sheet is shown on the following page, and another showing traffic on Van Buren Street is included with the article, "First Paving Mixer to Work in Chicago's Congested Loop District."

The census was taken by twelve men, divided into six groups of two men each, five being for actual service and one for relief. These men were selected from among the section foremen in the various wards of the city, and previous to commencing the work, they were instructed as to the necessity of accuracy. A team of men was assigned to each block, one on each side of the street, to count the traffic in each direction. This was continued for fifteen days, and observations were made in forty-three different blocks, between the hours of eight a.m. to twelve m., and one p.m. to six p.m., rain or shine. On Saturdays the men worked until two p.m., thus affording a means of counting the noon hour traffic.

The following statistics of traffic at different points in the down-town business and commercial districts were compiled for comparative purposes, and show the variations of traffic; also the congestion at certain points.

### RUSH STREET BRIDGE.

The census taken at this point showed the traffic to be heavier than at any other point in the city. For the eight hours in which the census was taken, figures show that an average of 1,700 vehicles per hour cross the bridge during the day, or a vehicle every 2.12 seconds.

During the hour between five and six p.m. the traffic was at its greatest. At this time of the day the trend of traffic is north bound. During this hour 2,384 vehicles crossed the bridge. Of this number 1,872 were north bound, which would average a vehicle every 1.9 seconds.

The difficulty which a pedestrian encounters in trying to cross the bridge during this hour may be imagined, with a vehicle of some kind passing every 1.5 seconds.

Traffic across the bridge was distributed as follows:

| | *Per Cent.* |
|---|---|
| Horse drawn vehicles | 19. |
| Auto trucks of all kinds | 6.31 |
| Automobiles | 74.69 |

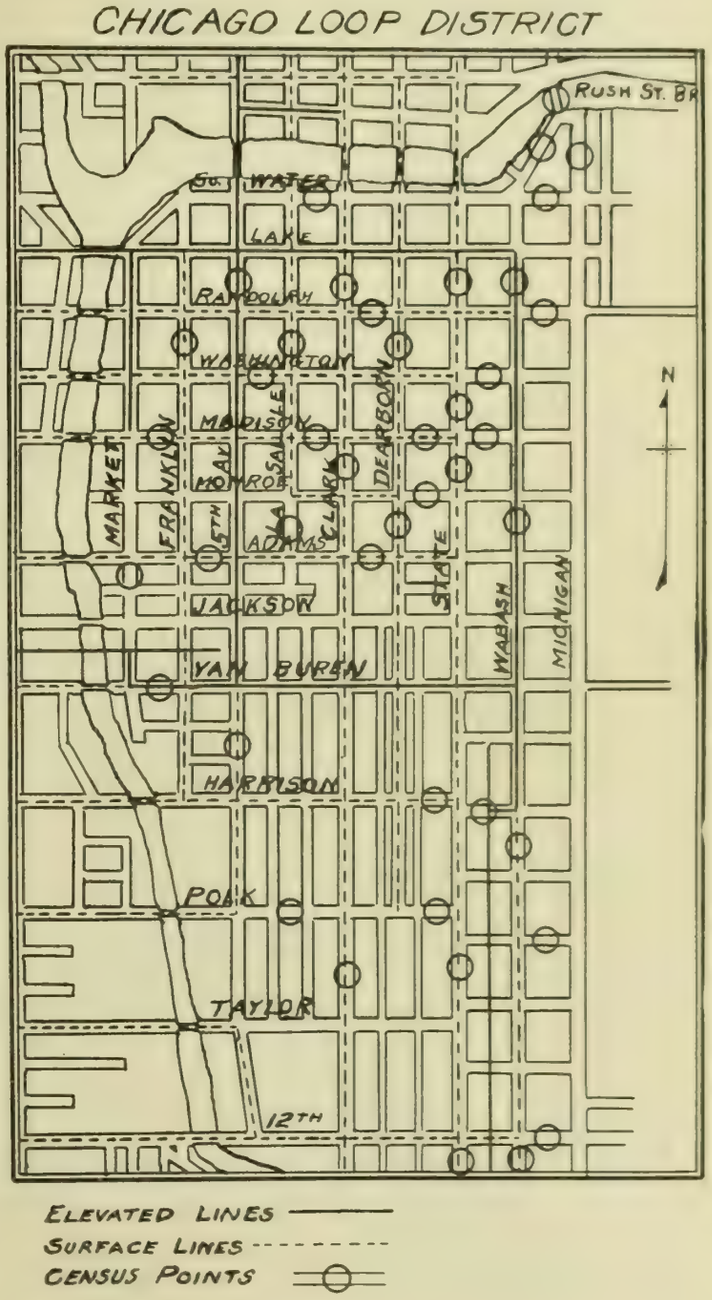
### STATE AND MADISON STREETS.

This intersection was found to be the busiest of the down-town streets. During the day on which figures were taken an average of 1,547.67 vehicles passed per hour, or a vehicle every 2.4 seconds; a street car every 11.8 seconds. Traffic was distributed as follows:

| | *Per Cent.* |
|---|---|
| Horse drawn vehicles | 43.17 |
| Auto trucks of all kinds | 7.43 |
| Automobiles | 29.69 |
| Street cars | 19.71 |

Of this traffic 75.7 per cent. was on State Street, while 24.3 per cent. was on Madison Street.

Traffic north bound in the block between Madison and Washington streets was thirty-five per cent. heavier than south-bound traffic, this despite the fact that there were 245 more streets cars south bound than in the other direction.




Figures taken at eleven different points on streets west of State Street show traffic to average 253.86 vehicles per hour.

At eleven different points on streets east of State Street the average per hour was 191.88 vehicles.

Traffic on State Street, between Lake and Adams streets, averaged 441.8 vehicles per hour.

SOUTH WATER STREET.

In order to ascertain the length of time spent by vehicles standing backed up to the curb in loading and unloading on this street and streets in the immediate vicinity (the commission house district), eighty vehicles of outside dealers were timed. These vehicles averaged one hour and twenty-seven minutes standing at curb, while ten other vehicles remained for an average of four hours and nine minutes.

The vehicles used for hauling fruit and produce to the commission houses averaged fifteen to thirty minutes in unloading and departing, while a number of vehicles owned by parties who do a cartage business, after unloading, remained backed up to curb for an indefinite time.

STREET CARS.

The new style heavy double truck street car is an important factor in street cleaning, as it also is in traffic census, when it is considered that, of the total number of vehicles counted, there were 26,995 street cars, or 14.38 per cent. of all traffic, and on the streets upon which there are tracks, cars amounted to 21.06 per cent. of the traffic.

Of the streets upon which there are regularly routed street cars, Dearborn Street south of Monroe Street has the lightest amount of street car traffic.

State Street from Lake to Madison Street has the greatest amount of street car traffic. At the intersection of State and Madison streets, going either in a northern, eastern, or southern direction, there is a car on an average of every 11.8 seconds.

Street car traffic on State Street, from Lake to Monroe Street, is nearly twenty-six per cent. of the total traffic.

| Time | Northwestern South Sides | Metropolitan All Branches | Chicago Oak Park | Total |
|---|---|---|---|---|
| 10 to 11 a.m. | 42 | 38 | 2* | 82 |
| 11 to 12 m. | 48 | 44 | 11 | 103 |
| 1 to 2 p.m. | 44 | 40 | 12 | 96 |
| 2 to 3 p.m. | 44 | 42 | 10 | 96 |
| 3 to 4 p.m. | 44 | 41 | 10 | 95 |
| 4 to 5 p.m. | 49 | 40 | 13 | 102 |
| 5 to 6 p.m. | 54 | 47 | 18 | 119 |
| Totals for day | 477 | 416 | 131 | 1024 |

*Between 10 and 11 a.m. Chicago and Oak Park trains were delayed fifty-five minutes.

A factor affecting street cleaning is the litter and newspapers thrown by careless passengers from the car windows of the elevated trains, constantly passing through the loop district each day. This is a violation of the clean street ordinance, but is a condition hard to correct.

CLASSIFICATION BY DISTRICTS.

Figures taken at seven points north of Randolph Street show:

Horse-drawn Vehicles—

| | Number | Per Cent. |
|---|---|---|
| Wagons of all kinds | 15,361 | 60.82 |
| Carriages | 34 | .14 |
| Buggies | 162 | .64 |
| Motor-driven Vehicles— | | |
| Auto trucks | 2,478 | 9.81 |
| Two-seated autos | 925 | 3.66 |

**TRAFFIC OBSERVED ON STATE STREET, BETWEEN MADISON STREET AND WASHINGTON STREET**

Date, July 19th, 1915. **DIRECTION TRAFFIC BOUND—*NORTH*** PAVEMENT—ASPHALT WEATHER—CLEAR

| TIME | RUBBER TIRED VEHICLES: AUTO TRUCKS LARGE Loaded | LARGE Empty | SMALL Loaded | SMALL Empty | AUTOMOBILES TWO SEATED | AUTOMOBILES FOUR OR MORE SEATED | WAGONS ONE HORSE Loaded | ONE HORSE Empty | TWO HORSE Loaded | TWO HORSE Empty | CARRIAGES | BUGGIES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 to 9 A.M. | 21 | 3 | 15 | 6 | 15 | 55 | | | 36 | | | 1 |
| 9 to 10 " | 37 | 6 | 6 | 1 | 22 | 98 | | | 34 | | 1 | 2 |
| 10 to 11 " | 22 | 15 | 15 | 3 | 45 | 176 | | | 26 | | 2 | 12 |
| 11 to 12 M. | 35 | 5 | 15 | 2 | 51 | 195 | | | 25 | | 2 | |
| 1 to 2 P.M. | 25 | 7 | 7 | | 76 | 153 | | | 14 | | | 2 |
| 2 to 3 " | 60 | 20 | 18 | 2 | 60 | 163 | | | 33 | | 2 | |
| 3 to 4 " | 45 | 15 | 16 | 5 | 92 | 235 | | | 38 | | | |
| 4 to 5 " | 41 | 5 | 12 | 1 | 49 | 202 | | | 37 | | 1 | 3 |
| 5 to 6 " | 38 | 7 | 25 | 6 | 90 | 216 | | | 40 | | | |
| TOTALS | 324 | 83 | 129 | 26 | 500 | 1493 | | | 283 | | 8 | 20 |

| TIME | IRON TIRED VEHICLES: ONE HORSE Loaded | ONE HORSE Empty | TWO HORSE Loaded | TWO HORSE Empty | THREE OR MORE HORSES Loaded | THREE OR MORE HORSES Empty | BUGGIES | STREET CARS | "L" TRAINS | HOURLY TOTALS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 to 9 A.M. | 115 | 47 | 76 | 41 | | | | 145 | | 576 | |
| 9 to 10 " | 99 | 55 | 82 | 43 | 1 | | | 83 | | 570 | |
| 10 to 11 " | 146 | 85 | 113 | 40 | 1 | 1 | 1 | 93 | | 796 | |
| 11 to 12 M. | 145 | 62 | 125 | 35 | | | | 91 | | 788 | |
| 1 to 2 P.M. | 126 | 62 | 95 | 41 | 1 | | | 75 | | 684 | |
| 2 to 3 " | 122 | 51 | 112 | 50 | 1 | | | 81 | | 775 | |
| 3 to 4 " | 148 | 56 | 136 | 45 | 1 | | 1 | 95 | | 928 | |
| 4 to 5 " | 180 | 68 | 115 | 20 | 3 | 1 | 3 | 140 | | 881 | |
| 5 to 6 " | 75 | 105 | 92 | 81 | 1 | | | 168 | | 944 | |
| TOTALS | 1156 | 591 | 946 | 396 | 9 | 2 | 5 | 971 | | 6942 | |

**DIRECTION TRAFFIC BOUND—*SOUTH***

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 to 9 A.M. | 15 | 11 | 2 | 8 | 4 | 18 | | | 1 | 19 | | | 37 | 44 | 34 | 18 | 3 | | 2 | 202 | | 418 | There are two south bound tracks on this street, from Lake to Madison W. for street cars. |
| 9 to 10 " | 15 | 8 | 6 | 2 | 16 | 57 | | | 3 | 28 | | 1 | 60 | 85 | 25 | 19 | 1 | 1 | 2 | 183 | | 511 | |
| 10 to 11 " | 14 | 7 | | 5 | 12 | 48 | | | | 16 | 1 | 3 | 18 | 51 | 26 | 25 | 1 | 1 | 1 | 83 | | 312 | |
| 11 to 12 M. | 13 | 11 | 3 | 3 | 13 | 74 | | | 3 | 11 | 2 | 1 | 22 | 75 | 25 | 18 | 2 | | 1 | 90 | | 367 | |
| 1 to 2 P.M. | 17 | 20 | 3 | 6 | 20 | 55 | | | 10 | 6 | 2 | 1 | 32 | 31 | 35 | 11 | 4 | 2 | 3 | 90 | | 348 | |
| 2 to 3 " | 7 | 10 | 6 | 6 | 19 | 77 | | | 18 | 1 | 1 | 2 | 52 | 31 | 32 | 9 | 2 | | 4 | 98 | | 363 | |
| 3 to 4 " | 14 | 11 | 1 | 8 | 16 | 75 | | | 19 | 2 | 2 | 1 | 42 | 56 | 37 | 20 | 2 | | 2 | 121 | | 439 | |
| 4 to 5 " | 14 | 8 | 1 | 3 | 20 | 83 | | 1 | 19 | | | | 35 | 50 | 29 | 21 | 3 | | 1 | 156 | | 444 | |
| 5 to 6 " | 3 | 13 | 1 | 5 | 12 | 64 | | | 19 | | | | 22 | 36 | 12 | 17 | | | 3 | 193 | | 400 | |
| TOTALS | 112 | 99 | 23 | 46 | 132 | 551 | | 1 | 96 | 83 | 8 | 9 | 320 | 459 | 255 | 157 | 18 | 4 | 17 | 1216 | | 3602 | |
| TOTALS OF BLOCK FOR DAY | 436 | 182 | 152 | 72 | 632 | 2044 | | 1 | 375 | 83 | 16 | 29 | 1476 | 1050 | 1201 | 553 | 27 | 6 | 22 | 2187 | | 10544 | |

ELEVATED TRAINS.

All elevated trains entering the loop run in the same direction on both sides. The trains were counted on Wabash Avenue at two points, and at one point on Fifth Avenue. In the counting of trains they were separated according to part of city to which they were destined. Trains on the east side of Wabash Avenue, north bound, to the North Side—Ravenswood, Wilson Avenue, and Evanston. Trains on the West Side were the Metropolitan and Oak Park trains, running to the West Side. An idea of the volume of this traffic may be obtained from the following tabulation:

*Elevated Trains—Randolph St. and Wabash Ave.—Aug. 23, 1915.*

| Time | Northwestern South Sides | Metropolitan All Branches | Chicago Oak Park | Total |
|---|---|---|---|---|
| 7 to 8 a.m. | 44 | 39 | 16 | 99 |
| 8 to 9 a.m. | 52 | 44 | 24 | 120 |
| 9 to 10 a.m. | 56 | 41 | 15 | 112 |

| | | |
|---|---|---|
| Four or more seated autos | 2,682 | 10.62 |
| Street cars | 3,615 | 14.31 |
| Totals | 25,257 | 100.00 |

Figures taken at ten points between Clark Street and Wabash Avenue:

Horse-drawn Vehicles—

| | Number | Per Cent. |
|---|---|---|
| Wagons of all kinds | 20,995 | 42.58 |
| Carriages | 133 | .27 |
| Buggies | 311 | .63 |
| Motor-drawn Vehicles— | | |
| Auto trucks | 4,634 | 9.40 |
| Two-seated autos | 2,986 | 6.05 |
| Four or more seated autos | 11,303 | 22.92 |
| Street cars | 8,948 | 18.15 |
| Totals | 49,310 | 100.00 |

(*Continued on page* 61.)




THAT MACHINE DEMANDS GOOD ROADS

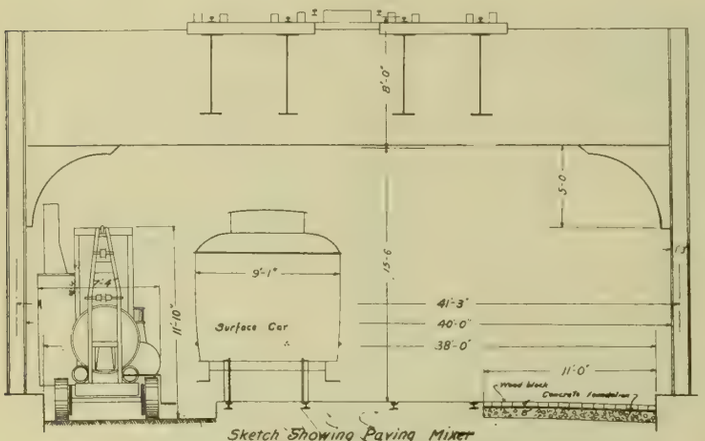
# First Paving Mixer to Work in Chicago's Congested Loop District

By Stanley E. Bates, Assoc. Mem. W. S. E.

THE repaving of Washington Street from Michigan to Wabash avenue, and from State to Clark streets and of Van Buren Street from Market Street to Michigan Boulevard, during the fall of 1915, saw the first paving mixer used in the congested loop district of Chicago. The honor belongs to a standard No. 16 Koehring equipped with boom and bucket.

Although Washington Street was the first of the two completed this article will deal more particularly with Van Buren Street, for the latter thoroughfare, in addition to a double track street car line, has an elevated railroad structure overhead, which made the successful use of the big paver an even more creditable feat. (For location of streets, see map of Chicago Loop District with article "First Traffic Census of the Central Business District of Chicago" in this issue.

The cross-section of Van Buren Street shown on this page, gives the governing dimensions of the roadway and shows the small space allowed for the paver to work, between the columns of the elevated structure on one side and the street cars passing on the other. In spite of this, the laying of the concrete foundation was carried on at a rapid rate and with the smallest possible interruption of traffic. The running of street cars was not interfered with at any time.




Sketch Showing Paving Mixer working on VAN BUREN STREET, CHICAGO underneath elevated railroad structure

Note - Dimensions given, in most cases, represent average figures. Actual dimensions vary a few inches one way or the other at different points.

The total Van Buren Street contract called for approximately 9,000 square yards of wood block pavement laid on an eight-inch concrete base. Prior to the paving, there was a large amount of underground water main and electric conduit work to be done. This was not entirely completed before the paving contractor began work, which caused some, though not serious, delay.

Grading was all done at night between 7:30 p.m. and 6:00 a.m. so that there would be as little interference with traffic as possible. The results of a traffic census taken prior to the paving, are given on this page. (See also article on Chicago Traffic Census elsewhere in this issue.)

Portable acetylene lights placed at frequent intervals along the street, in addition to the ordinary street lighting of arc lamps, furnished the illumination necessary to the work.

In previous down-town paving the concrete foundation has often been put in at night, but on Van Buren Street it was all done during the day-time hours, 7:00 a.m. to 5:00 p.m.

Details of laying the concrete differed little from any other job in which a paving mixer is used. The aggregates consisted of "torpedo" sand and gravel ranging in size from one-half-inch to two inches. They were delivered to the job by motor trucks, stored in piles in front of the mixer, and wheeled to the skip in barrows. The specified mix was 1:3:6 and each batch was made up of one sack of cement, one barrow of sand, and two barrows of gravel, each barrow holding three cubic feet.

Generally, however, the mix was made a little richer than specified, often an excess half sack of cement being added to the batch. The reason for this was that the engineer's check on the amount of cement used, consisted of a count of the number of sacks per unit gross area of pavement. For the eight-inch base of a 1:3:6 mix, the correct amount figured out to be one barrel (four sacks) to every 4.5 square yards, but on account of the large number of man-holes in the street, the net area of pavement, and consequent volume of concrete, was reduced by a considerable amount. Therefore, the extra amount of cement was put in, making the number of extra bags counted at the end of a day's work, check up with the gross yardage of concrete.

Mention might be made at this point that it is characteristic of the Ryan Company, who were the contractors, to leave nothing undone to produce a first-class job, using more materials in many cases, than a strict interpretation of the specifications would call for.

As previously stated, the underground work was not entirely completed when the pavement building began. As a result it was impossible for concreting to begin at one end of the job and be carried along continuously to the other end. Occasionally the mixer had to be moved ahead a few hundred feet skipping a space where the sub-grade was not prepared, and then later on, returning to fill in the remaining gaps. This fact should be borne in mind when studying the following time records:



Mixer Working on Washington Street

Twelve days were required to put in the concrete foundation, an average of 750 square yards of eight-inch concrete per day of nine hours. The largest day's work was on the one block, between Wabash and Michigan avenues where there are no car tracks or elevated structure; 955 square yards. The best record on the remaining ten blocks where there are both elevated and surface lines was 805 square yards.

As eight inches is somewhat thicker than the ordinary concrete foundations, the following figures are given on the basis of cubic yards:

| | |
|---|---|
| Average cubic yards laid per day | 166.7 |
| Average cubic yards laid per hour | 18.5 |
| Maximum cubic yards laid per day | 212.2 |
| Maximum cubic yards laid per day on car line section | 179.5 |

The following excerpts from the specifications for wood block pavements of the Board of Local Improvements, city of

**TRAFFIC OBSERVED ON VAN BUREN STREET, BETWEEN FRANKLIN STREET AND MARKET STREET.**

Date, July 21st, 1915. **DIRECTION TRAFFIC BOUND—*EAST***

| TIME | RUBBER TIRED VEHICLES: AUTO TRUCKS LARGE Loaded | LARGE Empty | SMALL Loaded | SMALL Empty | AUTOMOBILES TWO SEATED | FOUR OR MORE SEATED | WAGONS ONE-HORSE Loaded | ONE-HORSE Empty | TWO-HORSE Loaded | TWO-HORSE Empty | CARRIAGES | BUGGIES | IRON TIRED VEHICLES: ONE HORSE Loaded | ONE HORSE Empty | TWO HORSE Loaded | TWO HORSE Empty | THREE OR MORE HORSES Loaded | THREE OR MORE HORSES Empty | BUGGIES | STREET CARS | TRAINS | HOURLY TOTALS | PAVEMENT: SHEET ASPHALT; WEATHER: CLOUDY — REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 to 9 A.M. | 8 | 5 | 6 | 4 | 4 | 21 | | | 2 | | | 1 | 29 | 22 | 19 | 11 | | | 1 | 56 | 90 | [illegible] | |
| 9 to 10 " | 3 | 2 | 2 | 6 | 1 | 7 | | | | | | 2 | 30 | 33 | 10 | 5 | 1 | 1 | | 46 | 96 | [illegible] | |
| 10 to 11 " | 1 | 1 | | 3 | 5 | 15 | | | | | 1 | 1 | 33 | 35 | 18 | 5 | | | 6 | 55 | 41 | [illegible] | |
| 11 to 12 M. | 14 | 2 | 2 | 1 | 4 | 17 | | | 1 | | | 4 | 41 | 22 | 14 | 3 | 1 | | 1 | 55 | 44 | [illegible] | |
| 1 to 2 P.M. | 4 | 8 | 1 | 1 | 3 | 14 | | | | | | 1 | 24 | 25 | 13 | 7 | | | 2 | 56 | 46 | 179 | |
| 2 to 3 " | 10 | 3 | | 3 | 6 | 9 | | | | | | 4 | 26 | 31 | 6 | 4 | | | 4 | 56 | 41 | [illegible] | |
| 3 to 4 " | 5 | 3 | 5 | 1 | 4 | 19 | | | | 2 | 1 | | 34 | 25 | 7 | 9 | 1 | 1 | 5 | 60 | 40 | [illegible] | |
| 4 to 5 " | 3 | 2 | 1 | 2 | 3 | 13 | | | | | 2 | 2 | 36 | 31 | 15 | 6 | | | 2 | 55 | 49 | 224 | |
| 5 to 6 " | 7 | | 3 | | 4 | 12 | | | | | 1 | 2 | 30 | 15 | 6 | 2 | | | | 100 | 46 | [illegible] | |
| TOTALS | 55 | 26 | 20 | 21 | 34 | 127 | | | 3 | 2 | 5 | 17 | 283 | 244 | 108 | 52 | 3 | 2 | 21 | 483 | 389 | [illegible] | |

**DIRECTION TRAFFIC BOUND—*WEST***

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 to 9 A.M. | 1 | 2 | 6 | 3 | 3 | 5 | | | | | | | 21 | 15 | 10 | 2 | 2 | | | 44 | 46 | [illegible] | |
| 9 to 10 " | | | 6 | 3 | 2 | 9 | | | | 3 | | | 40 | 29 | 14 | 10 | 1 | | 1 | 45 | 54 | [illegible] | |
| 10 to 11 " | 1 | | 5 | 4 | 2 | 8 | | | | 1 | | 1 | 45 | 30 | 12 | 11 | 3 | | | 32 | 40 | [illegible] | |
| 11 to 12 M. | 2 | 1 | 3 | 1 | | 11 | | | 1 | | | 1 | 34 | 21 | 14 | 9 | | | 1 | 38 | 49 | 161 | |
| 1 to 2 P.M. | | 2 | 3 | 5 | 2 | 8 | | | | | | | 19 | 21 | 19 | 6 | | | | 37 | 35 | 153 | |
| 2 to 3 " | 5 | | 4 | 4 | 2 | 5 | | | | | | 2 | 45 | 25 | 14 | 14 | | | 1 | 36 | 41 | [illegible] | |
| 3 to 4 " | | 2 | 5 | 5 | | 12 | | | | 1 | | 1 | 45 | 30 | 19 | 12 | | | 1 | 42 | 56 | 211 | |
| 4 to 5 " | 3 | 2 | 3 | 4 | 1 | | | | | | | 1 | 29 | 23 | 18 | 8 | | 1 | | 47 | 39 | [illegible] | |
| 5 to 6 " | 1 | | 3 | | 4 | 12 | | | | | | 1 | 19 | 20 | 9 | 6 | 1 | | | 60 | 46 | 161 | |
| TOTALS | 13 | 13 | 38 | 29 | 22 | 78 | | | 3 | 5 | | 7 | 297 | 214 | 129 | 78 | 7 | 1 | 4 | 417 | 400 | 1675 | |
| TOTALS OF BLOCK FOR DAY | | 39 | 58 | 50 | 56 | 205 | | | 6 | 7 | 5 | 24 | 580 | 458 | 237 | 130 | 10 | 3 | 25 | 810 | 789 | [illegible] | |

Chicago, give details as to the kind of wood blocks used and the manner of laying.

CUSHION.

Upon the concrete foundation shall be spread a layer composed of one (1) part of Portland cement to four (4) parts torpedo sand, thoroughly mixed and dry, and in sufficient quantity to insure, when compacted, a uniform thickness of one-half (½) inch. In surfacing said layer the contractor shall use such guides and templets as the engineer directs. Immediately before laying the blocks the mixture shall be wetted by means of a rose head sprinkler with just sufficient water to partially cake it.

CREOSOTED WOOD BLOCK WEARING SURFACE.

*Blocks.* Upon the cushion shall be set the creosoted wood blocks.

The blocks shall be cut from southern yellow pine or tamarack timber. Only one kind of wood, however, shall be used on this work. The blocks shall be not less than five (5) inches in length, nor more than ten (10) inches in length, but shall average six (6) inches in length. The depth shall be four (4) inches, and the width shall be three and three-fourths (3¾) inches.

All blocks shall be made of sound timber and shall be free from any defects which will be detrimental to the life of the block or interfere with the proper laying of the same. Each block shall have at least sixty-six (66) per cent. of heart wood.

The blocks shall be carefully protected from the effect of the sun and weather before and after treatment and until laid.

*Timber.* The timber shall be that known to the trade as "prime" timber and of a texture permitting satisfactory treatment as hereinafter specified, and shall be subject to inspection at the works in the stick or at any time during the process of preparation or thereafter. The timber shall be sound, square-edged, free from bark, shakes, large or loose or rotten knots, red heart, worm or knot holes, or any other defects which will be detrimental to its strength or durability. So second growth timber or loblolly pine will be accepted.

With southern yellow pine timber, the annual rings in the three (3) inches measured radially from the center of the heart shall average not less than eight (8) to the inch.

When the timber for the blocks is only partially seasoned, the Board of Local Improvements may require the same to be piled in such a manner and for such a length of time as will prepare it for the treatment herein specified.

The Board of Local Improvements may at any time reject in bulk all timber that does not fulfill the above requirements, and order same removed and properly called before being returned to the mill.

*Treatment.* The blocks shall be placed in an air-tight cylinder where, by means of steam and the vacuum pump the sap in the blocks will be vaporized and the moisture in them removed. During the process of steaming a vent shall be kept open in the cylinder to permit the escape of water, air, and condensed steam in the cylinder. After the heating or steaming period, the drain or vent in the bottom of the cylinder shall be opened and all moisture removed from the cylinder. During the vacuum period the temperature in the cylinder must be above the boiling point of water under existing vacuum.

When the cylinder is thoroughly drained a vacuum of not less than twenty (20) inches (Hg.) shall be maintained.

When the blocks are thoroughly dry the cylinder shall be filled with oil destroying a vacuum of not less than twenty (20) inches (Hg.) and pressure shall then be applied and increased gradually to not more than two hundred (200) pounds per square inch and maintained until sixteen (16) pounds of oil have been forced into and retained in each cubic foot of timber and until the oil has impregnated the blocks to the satisfaction of the Board of Local Improvements. The pressure period on the oil shall be continuous and of a duration of not less than three (3) hours. After the surrounding oil has been removed, the blocks shall remain in the closed cylinder for a period of thirty (30) minutes to allow the excess oil on the surface of the blocks to drain off. The oil thus drained off shall be forced back into the treating tank in order to determine the amount of impregnation. In the process of treating the blocks, a correction must be made for any water contained in the cylinder. Compensation shall also be made for leaks and other wastes of oil that may occur during treatment.

If, in the treatment of the blocks, more oil is injected per cubic foot of timber than is called for in the specifications, such excess oil must not be removed. The temperature of the oil after entering the cylinder, shall be not lower than one hundred and sixty-five (165) degrees Fahrenheit. The cylinder shall be detrimental to its strength or durability. No second growth temperature throughout injection.

The oil tanks and cylinder in which the blocks are treated shall be equipped with the necessary gauges, thermometers, and draw-cocks in order to facilitate a thorough inspection of the materials and treatments. The cylinder shall be equipped with the proper connections and apparatus for artificially seasoning timber before the impregnation with the creosote oil.

The plant shall be provided with proper means for obtaining the absolute measurement and weight of all oils entering the cylinder and the amount of oil absorbed by the blocks.

*Oil.* 1. The oil shall be a distillate obtained wholly from coal tar.

2. It is required by this specification that the oil used shall be wholly a distillate oil obtained only by distillation from coal tar. No other material, of any kind, shall be mixed with it.

3. The oil shall contain not more than one (1) per cent. of matter insoluble in hot benzol and chloroform.

4. Its specific gravity at twenty-five (25) degrees Centigrade shall be not less than one and eight-hundredths (1.08) and not more than one and twelve-hundredths (1.12).

5. The oil shall be subject to a distilling test as follows:

The apparatus for distilling the creosote must consist of a stoppered glass retort having a capacity, as nearly as can be obtained, of eight (8) ounces up to the bend of the neck, when the bottom of the retort and the mouth of the off-take are in the same plane. The bulb of the thermometer shall be placed one-half (½) inch above the liquid in the retort at the beginning of the distillation, and this position must be maintained throughout the operation. The condensing tube shall be attached to the retort by a tight cork joint. The distance between the thermometer and the end of the condensing tube shall be twenty-two (22) inches, and during the process of the distillation the tube may be heated to prevent the congealing of the distillates. The bulb of the retort and at least two (2) inches of the neck must be covered with a shield of heavy asbestos paper during the entire process of distillation, so as to prevent heat radiation, and between the bottom of the retort and the flame of the lamp or burner two (2) sheets of wire gauze each twenty (20) mesh fine and at least six (6) inches



**Putting in Concrete Foundation on Van Buren Street**

square must be placed. The flame must be protected against air currents.

The distillation shall be continuous and uniform, the heat being applied gradually. It shall be at a rate approximating one (1) drop per second, and shall take from thirty (30) to forty (40) minutes after the first drop of distillate passes into the receiving vessel. The distillates shall be collected in weighed bottles and all percentages determined by weight in comparison with dry oil. When one hundred (100) grams of the oil are placed in the retort and subjected to the above test, the amount of distillate shall not exceed the following:

Up to 150 degrees Centigrade, 2 per cent.
Up to 210 degrees Centigrade, 10 per cent.
Up to 235 degrees Centigrade, 20 per cent.
Up to 315 degrees Centigrade, 40 per cent.

The distillation of the oil shall be carried to three hundred and fifty-five (355) degrees Centigrade. The residue thus obtained when cooled to fifteen (15) degrees Centigrade shall not be brittle, but shall be of a soft waxy-like nature so that it can be readily indented with the finger. When a small portion of this residue is placed on white filter paper and warmed, the oil spot produced, when viewed by transmitted light, shall appear of an amber color.

6. The tar acids of the distillate from two hundred and fifty (250) degrees Centigrade to three hundred and fifteen (315) degrees Centigrade must not be less than six (6) per cent. of this distillate (250° to 315° C).

7. The amount of the unsaponifiable oil (by sulphuric acid and caustic soda) in the distillate from two hundred and fifty (250) degrees Centigrade to three hundred and fifteen (315) degrees Centigrade must not exceed three and one-half (3½) per cent. of this distillate.

The contractor shall deliver to the Board of Local Improvements an affidavit from the individual manufacturing the blocks (if manufactured by an individual), from the managing officer of the corporation manufacturing the blocks (if manufactured by a corporation) and by an active member of the firm manufacturing the blocks (if manufactured by a firm), setting forth that all oil used for treating the blocks for this contract is a distillate oil obtained wholly and entirely by distillation from coal tar and that it is free from any adulteration.

*Laying.* The blocks shall be laid in parallel courses across the roadway at an angle of approximately ninety (90) degrees from the center line thereof, except at the intersections of all alleys, where they shall be laid at right angles with the center lines thereof. On intersections and junctions of lateral streets, the blocks shall be laid at an angle of forty-five (45) degrees with the line of the street, unless otherwise ordered by the Engineer. The blocks shall be laid with the fiber of the wood running in the direction of the depth. Gutters shall be constructed as directed by the Engineer. The courses shall break joints alternately by a lap of not less than two (2) inches and the blocks shall be driven together except where joints for expansion are constructed as follows: On each side of the roadway a longitudinal joint shall be formed by placing a one and one-half (1½) inch board on edge against the curb. The blocks shall be firmly laid against said boards. The boards shall remain in place until the blocks are rolled, and immediately preceding the application of the filler as hereinafter specified, they shall be carefully removed without disturbing the adjacent blocks.

The blocks, when set, shall be rolled with a steam roller weighing not less than five (5) tons, until firmly bedded and brought to a uniformly even surface. After rolling, all imperfect blocks shall be removed and replaced by perfect blocks. Broken blocks shall not be used except to break joints in starting courses and in making closures. If the blocks that have been laid should become wet before the filler is applied, they must be taken up and reset at the contractor's expense, if the Engineer so directs. In no case will teams be allowed on the work before the wearing surface is completed.

*Asphaltic Filler.* After rolling, the surface of the pavement shall be swept clean and the joints between the blocks and expansion joints shall be filled with an asphaltic filler which shall be free from water, coal tar pitch, or any product of coal or water gas tar. It shall adhere firmly to the blocks, be pliable at all climatic conditions to which it will be subjected, and conform to the following requirements:

It shall have a specific gravity of not less than nine hundred and sixty-five thousandths (0.965) at seventy-seven (77) degrees Fahrenheit.

It shall have a melting point of not less than one hundred and ten (110) and not more than one hundred and sixty (160) degrees Fahrenheit.

It shall have a penetration of not less than twenty (20) nor more than fifty (50).

The bitumen of the asphaltic filler shall be soluble in carbon tetrachloride to the extent of at least ninety-eight and one-half (98½) per cent.

The asphaltic filler shall be heated to a temperature of not less than two hundred and eighty (280) degrees nor more than three hundred and fifty (350) degrees Fahrenheit, and shall be applied in such a manner that all spaces between the blocks will be completely filled, the temperature of heating to be varied within these limits according to the nature of the asphaltic filler used, and at the discretion of the Board of Local Improvements. In applying the asphaltic filler care must be taken to use the least amount necessary to properly fill the joints and hold the top dressing. The blocks must be dry at the time of the application of the filler.

The contractor shall provide the Board of Local Improvements with a duplicate delivery ticket for each and every consignment of asphaltic filler delivered on the work. This ticket must be signed by the consignor and be of a form approved by the Board of Local Improvements.

(*Continued on page 62.*)

# West Virginia School of Good Roads

By A. D. Williams, Chief Road Engineer

THE School of Good Roads has been organized to meet the demands for instruction in highway engineering and road building and maintenance, and to comply with Section 17, Chapter 41, of the Acts of the Legislature, 1913, requiring all county road engineers to attend the office of the State Road Bureau at least ten days and receive instruction in road building.

The school is under the joint supervision of the university and the State Road Bureau, and is made the official school of instruction for county road officials.

When the Legislature of 1913 enacted the laws that established the Department of Roads at the West Virginia University, and created the State Road Bureau, there were less than one million dollars available in the State for road improvement, and but very little permanent road construction was under way or even contemplated.

Since the first road school was held in the State, a new spirit of road development has taken hold of the people. The amount of funds created by bond issue since May 1, 1915, is $2,780,000. By levies of 1915, more than $2,000,000 has been provided, and of the $2,240,000 authorized bond issues prior to May, 1915, a considerable portion of the funds remains unexpended.

Citizens of different communities have in contemplation and will vote upon more than five million dollars during the next six months; making a possible expenditure, during the next two years, on the public roads of the State, counting the levies of 1916, of an amount approximating twelve million dollars.

To get the most economical results out of the expenditure of these funds, the best possible business management and engineering skill must be applied.

For this reason, a gathering of the engineers, officials, and contractors of the State to discuss ways and methods, to exchange views and receive instruction, is of vast importance to all persons interested in the development of the roads and to all the people of the State. The engineers and officials entrusted with the responsibility of administering the road affairs of the counties of the State, occupy a position of great responsibility. A failure on the part of any official or any engineer affects the interest of many people and the entire movement for better roads. For this reason, all contractors, administering officials, and road engineers in the State, should avail themselves of the opportunity to attend the School of Good Roads, not only for the benefit that they might receive directly, but also for the good that they can confer upon others by giving their experiences in the discussions of the various subjects that will be considered and which affect all parts of the State.

The problem that confronts West Virginia to-day is a lack of trained men to take hold of the highway work and give it such careful consideration as the importance of the subject demands. The State has within its bounds many engineers that have achieved success in the special lines of engineering they have been following, who are not highway engineers because they have not given the subject such attention as should be given to do justice to themselves or the people. In a few cases, engineers that have succeeded in other lines of engineering have attempted highway work which, for the sake of all concerned, should have been left to the experienced highway engineer who had given direct consideration to the subject. In some other instances, men who have had little or no knowledge of engineering and have given but little consideration to the importance of the subject matter in the task they were undertaking, have made attempts at road construction that have been very costly to the community at the time of execution, and will still continue to be a cost by reason of the high maintenance charges due to improper location, alignment, and drainage. In each case, the community would have been benefited by these men coming in contact with trained men of experience and studying for a period of time the problems that they were to meet. A scientifically trained engineer can learn many things relative to the highway from a gathering of his associates who have been studying the highway problem. The untrained practical man and contractor can gain knowledge from like associations. The engineer, official, or business man who has conceived the idea that there is nothing that he can learn further from his associates, or nothing to be gained by attending an institution of learning and research, is either fossilized or else has not sufficient knowledge of the question before him to recognize the importance of the position he occupies, which in either case disqualifies him as an authority on a subject requiring as much scientific investigation and research as the highway problem of to-day.

It is not expected that a school of this duration could turn out experienced and efficient road engineers, but it is possible to focus the ideas of those who have given consideration to the great need of a broader knowledge of our highway problem. In bringing together the practical experienced men and the men of special training, it is possible to benefit both by an exchange of views and experiences which will help all persons to see further into the science of road building.

It is the aim of those directing the road school to make the lectures as practical and instructive as possible so that those attending will be benefited and prepared to give better service to the several communities of the State. All persons interested in the good road movement will find the advice and assistance of those who have made a special study of road building, to be of advantage. The road question is the greatest problem before the people of West Virginia to-day. It affects more lives, fortunes, and homes than any other question. Our financial, social, intellectual, and religious development are advanced or impeded with highway improvement or neglect.

We need trained engineers and road builders who will put their head, hand, and heart into the work. It is as impossible to get good roads from the hands of untrained men as it is to get good houses from the hands of untrained architects and carpenters. No man would think of building a house without the services of experienced designers and carpenters. Neither would he want to place valuable materials and equipment at the disposal of untrained hands, because it costs more than time to put untrained men in charge, especially if they are directing the energies of others where their mistakes will cost more than their own time. It costs money to train men, but it costs less to train them collectively than separately. All make mistakes, but we need not duplicate them. In this capacity, the road school can be of service to all county officials.

This is a day of specialization, and the people expect the man who follows any profession to be prepared and proficient in it. They do not expect him to cover many fields. If they want a law-suit tried, they get a lawyer; a funeral service held, a preacher; a horse doctored, a veterinarian; a tooth pulled, a dentist; a horse shod, a blacksmith; a farm surveyed, a surveyor; a house wired, an electrician; a house painted, a painter; and the time has come that, when they want a road, they realize the need of a trained road engineer and road builder. It is as impractical and unreasonable to say that every man can build a road as it is to say that a blacksmith can extract and fill teeth, or a lawyer paint and paper a house.

Many of the fields of study that confront the road builder are filled with hidden secrets that time and research will reveal to the careful, investigating mind. The highway problem is not mastered, but each man who attempts to perform the duties of a highway engineer or administering official owes it to himself and surely to the community whose funds he is handling, to equip himself with all of the available information he can possibly procure upon the subject, and to keep constantly in touch with the men and institutions that are investigating the problems with which those interested in the construction of our roads are confronted.

West Virginia roads present many problems that call for careful investigation and study. The university, with its laboratory, library, and trained staff of specialists and State Road Bureau in co-operation with the United States Bureau of Standards, and Office of Public Roads State Geological Survey and Experiment Station, offer service and ask the people of

(*Continued on page* 58)

# Large Manufacturers Take Positive Stand Against More Than One Road Congress in 1916

EVERY reader of Better Roads and Streets, and every manufacturer of road- and street-building equipment and of materials in the United States, is familiar with the unyielding stand that this publication has taken against the holding of more than one road congress and exhibition of equipment and materials annually. It will be remembered that we published, in January, 1914, a list of the signers of the "Round Robin" that was circulated among the exhibitors at the exhibition held in connection with the annual convention of the American Road Builders' Association, in which they declared themselves in favor of the holding of but one road congress and exhibition annually. This stand was heartily approved, as was evidenced by the fact that subsequent signers to the number of approximately two hundred were secured. Better Roads and Streets has bitterly opposed the holding of more than one road congress and exhibition, and will always continue this opposition. In this stand, we are strongly supported by almost every manufacturer of consequence in the United States.

It will be remembered that the exhibitors at the Chicago Road Congress last winter, held a meeting, at which an agreement was signed stating that, unless the American Road Builders' Association and the American Highway Association got together and jointly held but one annual road convention and exhibition of equipment and materials, they would positively refuse to exhibit at congresses and exhibitions held by either of the above-mentioned associations. There were twenty-seven signers to this agreement. These twenty-seven parties to this agreement include the largest manufacturers of road-building equipment and materials in the United States, and without their co-operation financially (in contracting for exhibit space at an exhibition), no road exhibition can be much of a success. They were all heartily sick and tired of being forced to attend one exhibition after another, necessitating the expenditures of large sums of money in rental of space, transportation charges and hotel expenses, entertainment expenses, etc., all of which has to be charged up against advertising. They also objected to the time and money lost through having to take their road men away from their respective territories, as the salaries and expenses of these men must be charged against the congress and exhibition, and in turn charged up to advertising. One large concern admitted to the writer that the cost of attending road meetings and exhibitions in 1915 was something over TEN THOUSAND DOLLARS.

The one road congress for the season of 1915-1916 has been held. The two associations did get together and held this more or less successful meeting at Oakland, California, last September. Manufacturers considered that this was the final meeting until the two associations again held a joint meeting during the winter of 1916-1917; but in this fond belief they find they have been misled. Immediately following the announcement that a congress and exhibition would be held in Pittsburgh next month, there were a number of conferences, as well as much letter writing, among the signers of the agreement in Chicago last winter.

The result of these conferences is that twenty of the twenty-seven signers to the agreement have positively reiterated that they will not exhibit unless the two associations get together and hold a joint meeting. At the present writing, two of the twenty-seven seem to be in favor of ignoring the agreement, while the remaining five have not been heard from. Among the concerns that have positively stated that they will strictly live up to the agreement, are the following:,

Amies Road Company, Easton, Pa.

Association of American Portland Cement Manufacturers, Philadelphia, Pa.

Barber Asphalt Paving Company, Philadelphia, Pa.

Barrett Manufacturing Company, New York City and Philadelphia.

Headley Good Roads Company, Philadelphia, Pa.

Jennison-Wright Company, Toledo, Ohio.

Kinney Manufacturing Company, Boston, Mass.

Ohio Tractor Roller Sales Company, Columbus, Ohio.

National Paving Brick Manufacturers' Association, Cleveland, Ohio.

Prudential Oil Corporation.

Solvay Process Company, Syracuse, N. Y.

Tarrant Manufacturing Company, Saratoga Springs, N. Y.

Thew Automatic Shovel Company, Lorain, Ohio.

Troy Wagon Works Company, Troy, Ohio.

Universal Portland Cement Company, Chicago, Ill.

Warner-Quinlan Asphalt Company, New York City and Syracuse, N. Y.

Warren Brothers Company, Boston, Mass.

Watson Wagon Company, Canastota, N. Y.

This standing together of the manufacturers has a far greater importance than many would suppose. For years, the manufacturers have felt that they have had to exhibit at the various so-called "national congresses," and some of them have, in fact, felt that they would be taking a chance if they did not secure exhibition space. But now, the larger concerns feel that they have the upper hand through the fact that so many of the most prominent in the country are standing together for what they know is the right move, and which will do them just as much good as the several congresses have in the past, and at the expenditure of considerably less money for conventions. They realize that they have right now the opportunity that they have never before had, and that all they will have to do to gain the end that they desire is to stand together by remaining away, as exhibitors, from all national congresses and exhibitions, until the national associations forget their petty jealousies of each other, and unite in holding annually, in January or February, one great national road congress and exhibition of road-building machinery, equipment, and materials.

Such a national road congress is badly needed, and should be held. Better Roads and Streets advocates it and would support it in every possible manner. The manufacturers would support it, and if it is held in the right section of the country, it would, without the possibility of doubt, be the greatest and most successful road meeting and exhibition ever held. And it is now up to the manufacturers whether such a great congress is going to be held annually. If they desire to see it, they will line up on the side of the large and powerful business concerns enumerated on this page, thus bringing about a road meeting and exhibition that will boost road construction, maintenance, and repair far more than is ever possible, or ever will be possible, by the old method—multiplicity of "national" road conventions.

The editors of Better Roads and Streets desire to make it plain that this article is not written as an attack on the American Road Builders' Association. It is not an attack on any association, and would have been written in just the same tone had the announcement been made that the American Highway Association, the other large national road association, or in fact any other organization, had announced that another road convention would be held under its auspices this season. The mere fact that the meeting is not to be held in 1915 but a couple of months later in 1916, appears to be merely an evasion of the agreement that the two associations would hold but one meeting in 1915. Although from a legal standpoint the agreement of the two associations has not been broken, it morally is being broken by the announcement that there will be a road meeting in Pittsburgh next month. These meetings are always held in the winter, and the road congress of the winter of 1915-1916 was held at Oakland, California. The dates were simply pushed forward a few months in order to give the members the opportunity to attend the meetings of the International Engineering Congress, but this advancing of the dates does not warrant the claim that that congress was not the one intended to be the representative one of this winter.

Another thing that is to be given consideration in the holding of an annual joint road congress is that the attendance would be larger and more representative, and that it would be much easier to secure a greater number of the most prominent

(*Continued on page* 58.)

PROGRAM FOR REPAIRS AND RENEWALS OF BRIDGES AND CULVERTS

COUNTY

| IDENTIFICATION | | | | REPAIRS | | | ESTIMATED COST IN DOLLARS | | | | | | | | | RENEWALS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BRIDGE No. | ROAD | LOCATION | STREAM | TYPE | SIZE | CONDITION AND DESCRIPTION OF REPAIRS | PIPE | STEEL | TIMBER | MASONRY | CONCRETE | PLANK | FLOOR | [illegible] | MISC. | TYPE | SIZE | [illegible] | [illegible] | TOTAL |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
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# Inspection of County Bridges and Culverts

By J. R. Chamberlin, Deputy, Bureau of Bridges, State Highway Department of Ohio

ONE feature of the new highway law which went into effect in September was a provision for the inspection by the county highway superintendent of all highway bridges and culverts within the county, and a report to the highway commissioner and county commissioners as to the condition thereof. Also that the county highway superintendent shall, prior to the first of April of each year,

..... County **BRIDGE** .....Twp.

.....Road. Bridge No. .....

located ..... miles ..... of.....

.....over.....

Type..... Kind of substructure.....

Span or spans c. to c..... Sub-foundation .....

Width of roadway..... Sub-struct. built 19..... cost $.....

Height of floor above low water..... Super- " " 19..... cost $.....

Kind of floor..... Remarks.....

Approaches.....

REPAIRS

| YEAR | DESCRIPTION | COST |
|---|---|---|
| | | $ |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

furnish an estimate of the probable amount of funds required to repair the bridges and culverts, or erect necessary new ones.

The importance of this section of the law can be appreciated when we recall the fact that there is probably an average of five thousand structures in each county, which in some sections at least, have received no attention, except when failure of some sort occurs, such as when a culvert washes out and the road becomes unsafe, or a bridge floor through decay becomes so noticeably dangerous that the citizens of the community notify the county authorities concerning its condition. There have been a great many steel bridges built in the past twenty-

..... County **MASONRY ARCH** .....Twp.

.....Road. Bridge No. .....

located ..... miles ..... of .....

.....over.....

Material Arch section.....

Span or spans ..... Kind of roadway surface .....

Rise..... Approaches.....

Spring line above low water Built 19..... cost $

Length of barrel Remarks.....

Roadway above crown approx

REPAIRS

| YEAR | DESCRIPTION | COST |
|---|---|---|
| | | $ |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

five years whose deterioration from corrosion has been so rapid that if some systematic form of maintenance is not adopted, they will sooner or later give way under a heavy load. It is in fact surprising that more accidents have not occurred due to this cause.

The new law provides that all structures be inspected at least annually by the county highway superintendent, which means that if further deterioration goes on, it will be with the full knowledge of the county authorities.

The State highway commissioner has prepared general instructions to the county highway superintendents, providing for a systematic record, which will show, not only the location of the bridge or culvert, but also the condition of the structure at each time of inspection. It provides for keeping in the office of the county highway superintendent a card for each bridge and culvert. Upon the card will appear the name of the road, the bridge number of the structure, and the location of the bridge by rough measurements from a corporation line, township line, the beginning of the road, or some such

**REPORT ON THE CONDITION OF BRIDGES AND CULVERTS**

Inspected during year County

| NUMBER | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|
| Steel Bridge Superstructure — Structural Members | | | | |
| Steel Bridge Superstructure — Painting | | | | |
| Wooden Bridge Superstructure | | | | |
| Concrete Beam or Slab Superstructure | | | | |
| *Stone Substructures | | | | |
| *Concrete Substructures | | | | |
| *Iron or Steel Substructures | | | | |
| *Timber Substructures | | | | |
| Concrete Arch Bridges | | | | |
| Stone Arch Bridges | | | | |
| Sq. Yds. Plank Floor | | | | |
| " " Wood Block Floor | | | | |
| " " Concrete Floor | | | | |
| " " Other Pavement | | | | |
| Concrete Box Culverts | | | | |
| Stone " " | | | | |
| Vitrified Pipe Culverts | | | | |
| Concrete Pipe Culverts | | | | |
| Cast Iron Pipe Culverts (Solid) | | | | |
| Cast Iron Pipe Culverts (Sectional) | | | | |
| Corrugated Pipe Culverts | | | | |
| Wood Box Culverts | | | | |
| Other Types of Culverts | | | | |

*Substructure to include all piers and abutments of a particular bridge. In case a substructure is a combination of two or more materials classify as being of that material of which there is most or enter one half of one and one half of another. Pipe or box culverts less than 12" in greatest dimension not to be included.

The above statement of conditions is the result of inspection made by

and covers of the total mileage of the roads of the county.

(Signed

County Highway Superintendent

This paper is Manual 3.4-B

feature easily described. There are provided on the cards blank spaces in which a record may be kept showing repairs as they are made from year to year. On the reverse side of the card will appear a result of each inspection, showing the date of inspection, the condition of the structure as to painting, wearing surface of floor, masonry, etc. This form also provides for a symbol indicating whether or not the repairs recommended are of immediate importance in the matter of safety to the traveling public, or whether the work recommended is intended to prevent further deterioration of the structure.

.....County **CULVERT** .....Twp

..... Road. Bridge No. .....

located ..... miles ..... of.....

Type ..... Built 19 ..... cost $ .....

Material..... Remarks.....

Size..... .....

Length.....

Depth of fill over top.....

REPAIRS

| YEAR | DESCRIPTION | COST |
|---|---|---|
| | | $ |
| | | |
| | | |
| | | |
| | | |
| | | |

A compilation or summary of the work recommended will be made by the county highway superintendent and submitted to the proper executive authority for approval. This compilation as furnished by the county highway superintendent will serve as a tentative program for the expenditure of funds available for such work in any one year.

A summary of the inspection, as made by the superintendent, will show in a general way, the condition of the bridges in the county, and should afford a valuable guide for planning future work. It will also show the condition as good, fair, or bad of various types of culverts or bridges, also will show the relative merits of various types of floors, culvert pipe, etc., and also furnish valuable information for the executive officers in fixing the tax levy for bridges, for, if an inspection shows a large per cent. of the bridges were classed as in poor condition, in spite of the annual repairs that had been made in the past, it would be apparent that more funds were needed to correct this condition.

One feature of this inspection and report is the numbering of all structures in the State by the county highway superintendents. In some counties there are at present very systematic records kept of bridges, and the same are numbered in accordance with this system. In such counties, the scheme for numbering already adopted will remain in use. If no system for numbering bridges already exists, a scheme is provided. It calls for first, numbering all the roads. (Inter-county highways already are numbered.) The bridges are then to be numbered consecutively on that road, beginning at the most southerly or westerly end, or in case of inter-county roads, at the south or west county line. The bridge number as it is to appear on the structure will be composed of two numbers, thus: 157-41, which will mean that the bridge is the forty-first structure beginning at the south or west end of Highway No. 157.

*A traveler can select his route by numbers, and keep the road by noting the bridge numbers. Thus to go from Cincinnati to Chillicothe he would take I. C. H. No. 8. The figure eight would appear on all bridges on the route.*

# First National Convention of American Association of Engineers

WAYS and means of bringing about a greater appreciation of the engineering profession and the services of the engineer to the community and to the nation, formed the principal topic of discussion at the first national convention of the American Association of Engineers, held at the LaSalle Hotel, Chicago, December 10-11, 1915.

This subject has been given increasing attention during recent years and has been discussed at meetings of the various engineering societies and in the technical press. It has remained, however, for the newly organized Association to go to the root of the matter and by well-directed energy, and lots of it, to start a movement which promises to assume vast proportions and accomplish more towards the material and social welfare of engineers as a body, than has ever been accomplished before.

It is a well-known fact that, while wages and salaries in practically every other line of work, from day laborer to bank president, have increased greatly within the past few decades, there has been no similar rise in the compensation of engineers. There are many reasons for this; well known to all and unnecessary to be recounted in detail.

Figures compiled by the Association from reliable data show that the *salary of the average engineer is less than that of the average tradesman.* Even worse, the figures show that to maintain the necessary standard of living requires expenditures almost equal to his salary. Applying the facts along another line it is shown that an engineering education, figured as a business investment, is actually a losing proposition to the average technically trained engineer; in other words, he would get a greater return on his money if put into a savings bank rather than into an education!

It is to correct this condition of affairs and to render other equally important services to the profession that the Association was formed in Chicago last spring. The keynote of the Association is co-operation, and through co-operation the progress made in eight months is little less than astounding.

Bulletin No. 2 of the Association sums up some of its aims and purposes, and is given in part, herewith:

TO TECHNICAL MEN:

The American Association of Engineers has been organized by representatives of 300 Commoner Engineers of Chicago for the following purposes:

1. By affording means for the interchange of information.
2. By maintaining a Service Clearing House.
3. By affording patent and legal advice.
4. By supervision of legislation.
5. By proper publicity.

This Association will be devoted to the best interests of the AVERAGE engineer of good standing. NOT to elevate the ALREADY ELEVATED, but to bring up the standing of the RANK and FILE to that attained in other professions. We solicit the support of the Big Engineer and Employers of Engineers and aim to command their respect through the above methods and in the course of a little time (within your lifetime) secure the same standing for the Commercial Engineering Profession as that enjoyed by the Legal, Medical, and Military Professions—Material Compensation, Consideration, and Self-respect.

Why is the average graduate in Civil, Mechanical, Electrical, Chemical or one of the dozen other engineering branches, after five or ten years of labor in his chosen field, still treated with the consideration given to day laborers and no recognition given to his part in the big commercial achievement resulting directly through his efforts?

It is because there is no organized effort to show these results and they are being usurped by others. These men (you and I) are so concentrated on the technical points of our daily labor that we overlook the big fundamental law that "he who does not speak for himself will be cursed by small praise." We must have a *Speaking Trumpet* for the Commoner. We need at least 5,000 of the 50,000 men who are doing the engineering work before we can expect to gain recognition.

THE CONVENTION.

Fully five hundred men attended the Saturday afternoon session of the convention, many coming from quite a distance

from Chicago. Interfering with business hours, the other sessions were not quite so well attended, but enthusiasm was marked at all times.

The program follows:

*Friday, December 10. Morning Session.*

Welcome to Engineers—
H. S. Baker, Assistant City Engineer of Chicago.
Opening Address—
W. D. Wilcox, President (Gas Engineer).
Response—
F. H. Newell, Professor of Civil Engineering, University of Illinois (formerly Director of U. S. Reclamation Service).
Report of Association Work—
Arthur Kneisel, Secretary.

*Afternoon Session.*

Address, "Qualifications"—
T. P. Lambert, Vice President (Power Engineer, Chicago Telephone Company).
Discussion Hour.

*Evening Session.*

Banquet, Speakers—
Everett Jennings, Capt. H. B. Wild, Aviator.

*Saturday December 11. Morning Session.*

Address, "Relation of Patent Rights to the Engineer"—
G. Willard Rice, Patent Attorney, Rochester, N. Y., Chairman of Committee on Patent Advice.
Address, "Selling A. A. E. Memberships to Engineers"—
A. H. Krom, Electrical Engineer, Springfield, Illinois, Chairman Membership Committee.

*Afternoon (Chicago) Session.*

Illustrated Address, "The Economic Aspects of Engineering Pay"—
J. H. Prior, Chief Engineer, State Public Utilities Commission of Illinois.
Conferring of Ritual on Members.
Business Session.

Space forbids even a summary of the addresses and the suggestions made at these sessions. One point, however, will be outlined briefly, namely, that the best means of bringing about increased compensation for engineering services is not to limit the supply of engineers but to increase the demand, thus differing radically from trade union methods.

It was pointed out that many branches of work, now administered largely by laymen, belong logically within the province of the engineer, and that the association should strive by means of organized publicity, to impress this fact upon the public.

The office of City Manager, recently created in many of our American municipalities, was cited as an example of such positions, and the city of Dayton, Ohio, as an excellent example of a city whose manager is an engineer. If more road and street engineers had been present at the convention, doubtless other public offices would have been suggested.

The following excerpts from the "Qualifications of Certified Engineers of the American Association of Engineers" should be interesting to all those of our readers who are engaged in engineering work, whether graduates of technical schools or not, for the Association is by no means for technically trained man alone.

The American Association of Engineers being primarily an Association to gain better recognition for the Technical Profession must base its activities upon the personal qualification of its individual members.

Associate membership is given to all of those who are not directly engaged in technical pursuits, or those who may have a desire to assist in the elevation of the profession in other directions than the Certification and Employment Promotion (Service Clearing House) Departments.

Certified Membership, according to our Constitution, may be extended to any citizen (or one who has taken oath of intention to become a citizen) of the United States of America, of good moral character, who is engaged in any branch of the sciences or technical arts, who shall be a graduate of any recognized technical school or college, who shall have had not less than two years' practical experience subsequent thereto, or who shall in lieu thereof, have had five (5) years' practical experience in engineering work.

It is assumed that the applicant who has five years' practical experience as an engineer must have acquired sufficient technical knowledge to enable him to fill his position to the satisfaction of his employer.

Any certified member may register his name in the Service Clearing House Department and when so registered the Secretary will send to such members notice of all new enterprises and inquiries for technical men according to their classification.

Such registered members may file documentary evidence relative to their experience and ability for the purpose of enabling the Department to better represent their cause.

No attempt will be made to regulate or stipulate salaries of members, but where practical, rates for consulting *Services* and classified engineering work such as investigations, researches, analysis and estimates of costs requiring professional services to the general public will be classified and schedules of adopted minimums will be issued for the benefit of both the public and the profession at large.

To summarize the certification of Engineers by the A. A. E., it is the fundamental channel through which we will elevate the standard of both compensation and ethics of the profession:

First: By establishing and demonstating the recognizable worth of engineers in the various fields of industry.

Second: By eliminating the mediocre incumbent of positions requiring engineering skill and substituting therefor men of such ability as will redound to the elevation of the engineering profession through the element of efficiency.

Third: By assisting men with engineering qualifications into positions where their skill will become productive and recognized.

Fourth: By associating in a co-operative spirit and willing action, shed upon the world a light representing usefulness to ourselves as well as to the industries to which Engineering is but a servant in the interest of a better world.

Further information about the Association will gladly be given by Arthur Kneisel, Secretary, 29 South LaSalle Street, Chicago.

# Kentucky

GOVERNOR-elect A. O. Stanley, of Kentucky, in one of his recent campaign speeches said: "To say that you are in favor of good roads is really saying that you are in favor of good health or good morals, good atmosphere or good laws, or good everything else. Anybody not a fool favors good roads just as he favors good health or good weather. We all favor good roads who have sense enough to travel over them. The question is, not whether it is desirable to have better highways in Kentucky, but how we shall obtain them. The question to which any intelligent citizenship should first address itself is not, "shall we donate," but "should we invest the money toward this great work." To get this money you must, in a way, take it from the people, with their consent, by taxation.

"But the people are not going to tax themselves to build the roads unless they are convinced that it is a good investment. And whenever the people find that they are making money by expending money upon the roads you will get the money just as quickly as you would secure it from a farmer you have convinced that he would make money by buying an addition of 1,000 acres to his farm that is for sale nearby. There is no trouble to induce men to spend money when they are certain or reasonably certain of a safe return. Now is the expenditure of many thousands of dollars for good roads a safe investment?

MONEY AND RESULTS.

"I am separating it from its moral and aesthetic, its sentimental side. I am talking to you about the propriety of ex-

pending money for roads as I would talk to a farmer about the spending of money for land. As I would talk to the manufacturer of the proprietary of spending money for machinery, as I would talk to the mine owner of spending money for a tipple, or an option upon so many acres of coal land.

"A great mistake that farmers have made is in not making a business-like calculation as to the cost of production, which bears a direct relation to the advisability of constructing good roads. A short time ago Charles L. Schwab, former president of the United States Steel Corporation and now president of the Bethlehem Steel Company, the most gifted of all the great industrial masters of finance, made this startling statement: 'One-third of the cost of the production of all steel products, is the cost of transportation.' And one of the secrets of Schwab's phenomenal success was that he never calculated the cost of anything made of steel from a needle to a thousand tons of armor plate that he did not calculate the cost of laying it down, f. o. b., to the consignee. The farmer does not calculate. He calculates the cost of production in a rough way by taking cost of the land, taxes, labor, and tools, when he has calculated what it costs him to get in fifty bushels of wheat on his wagon, or a thousand bushels of corn in his bin completes his calculation. But he has not estimated the cost of that article in its entirely, for no man comes to the bin for his corn or to the thresher for his grain. Until he has calculated the cost of transportation he has not made an accurate estimate of the real cost of production. What is the actual value of a free public highway? Let us see—four good horses and a wagon, for example, the four horses, at $150 apiece, $600, and the cost of shoeing, harness, is to be considered, the whole



GOVERNOR A. O. STANLEY

will cost not less than $1,000; adding in the cost of maintaining these four horses, say at $8 a month, is $500 a year, and you have that to add to the original cost. In six years your $1,000 in horses and wagon is gone, as they will be worn out. The maintenance will cost you not less than $600 a year—$2 per day. We may say that the same teams will do double the work over a macadam road that they will do over a dirt road. So that the farmer in the item of four-house team, wagon, and driver has saved at least $1 per day by the use of macadam roads. When the farmers have calculated the saving in the one item of transportation, the taking of their products to market, leaving out the pleasure of traveling over macadam roads to himself and his family, leaving out the advantages to the children in attending school and his family attending church, leaving out the features of bringing closer to market or to mill, on the plan basis of dollars and cents, there is no better investment to the producer than in the making of a cheap and convenient means of bringing the farmers' commodities to the market.

THE HIGHER VIEW.

"But let us take a broader and a higher view. Every man who casts his ballot in the hope of receiving some pecuniary or personal benefit either in emoluments of office or some pecuniary advantage is a menace. By that I mean that the man who votes simply to keep up some political organization, the man who votes at the call of a boss, the man who votes for money in hand; is a menace to the liberties of a free people. This Government rests upon the disinterested devotion to high ideals of its citizenship, it is the foundation upon which the republic rests because a majority absolutely rules in this country. And whenever that majority ceases to be honest this Government will topple like a house of cards.

"What has preserved this Government for 150 years or more? I will tell you—The simple citizen seated in a cane-bottom chair on a rag carpet, before an open fireplace, with a Bible on his knees and his family grouped about him, his head bowed, simply and reverently asking God to guide him through the night, and arising in the fear of that same God at dawn to take up the simple tasks of the day. He votes with no thought of profit to himself, but for the good of his family and the honor of his country, and the glory of his God. This is the power upon which this republic rests and must forever rest. Now we talk about this simple life, its high ideals, and its noble purpose and yet there is in Kentucky a continual exodus from the country to the town. I make no warfare upon the city. I have lived in towns the most of my life, but what I mean to say is, that what we need is more good people on the farms in the country. It will cheapen the cost of living in town. It will bring more customers, and new life and new capital to our great cities. It is an invincible instinct for men to seek the society of their fellows, to gather as we have gathered here to-day in great multitudes. It is as natural as for partridges to gather in covies in the field, or birds in flocks in the sky. It is essential to the happiness, the mental and moral welfare of mankind, just so much as food or clothing. The thing that has destroyed rural life, the thing that has depopulated fertile lands is the loneliness and isolation of life in the country. Our girls and boys who live in rural districts are literally marooned in the winter, without access to the post office, the church, or the school; to the doctor in time of sickness, or the store for the bare necessities of life in any other way than on a mule, belly deep in the mire. Our boys and girls simply will not be kept in the rural districts ten miles from any town under such conditions, however much you may talk about the noble life of the country. It is too often the most lonesome existence on earth. If you wish to live in the country and bring up your family around you, if you wish them blessed by the things which are good and sweet in the rural life; then you must give them the pleasant things of life in the city. Build good roads to the city, you will lose none of the seclusion and sweetness of the country. The sunshine and dew and the landscape are still there, the fertile fields and the lowing herds, and the scent of new mown hay, and the silent benediction of the evening still are yours. With good roads and an automobile—if you cannot get an automobile, borrow a Ford—the wife and her boys and girls can go to church, they can go to the fair, they can go to places of amusement, they have the advantages of the pleasures of the city, and you have not been deprived of your country home or anything that makes it desirable or lovely. You will never solve the question of 'back to the country' until you have made the country more attractive. You cannot keep your family in the country with ten or twenty miles of impassable dirt roads between them and the things they want for nine months in the year.

INCREASE IN PROSPERITY.

"The country will be happier, more thickly inhabited, if the roads are improved, and the city will find an increase in prosperity whenever you unite the two by macadam roads.

"Both political parties—I am not here to talk politics—have condemned the contract labor system; both parties have told you that they are in favor of employing convicts upon the roads. Now the counties have the right to employ whom they please with the money they raise themselves, and it is a vexed question to what extent, where the State can force the convict labor upon the counties, coming as it must, more or less, in competition with free labor. In Edmonson County, especially, we have an unlimitable deposit of rock asphalt, the

finest road-making material known, a material that will cover your macadam roads with waterproofing a thousand time more indestructible than oil; a substance hard, yet elastic, that is as enduring as marble. And yet this vast and priceless deposit to-day is reached only by dirt roads that are almost impassable. This is a disgrace to Kentucky. I would see, and I hope to see, the labor of convicts, as well as others, employed in the development of these great quarries, and I hope to see this, the greatest road-making material ever known, spread over 5,000 miles of boulevard all over Kentucky, from mountains to Mills Point. (Great applause.).

"I could talk to you for a week upon this subject. Oh, it means so much to Kentucky as a State, and there is much to expect from the developments of good roads. No other State in this Union has such a variety and wealth of undeveloped resources: more coal than Pennsylvania, more hardwood than any other commonwealth between the Mississippi and the Pacific, and more acres of fertile soil than any other State of like area between the two oceans. Our soil produces a greater variety of products than any other on this earth. Why is it that the wealth of the mountain and the wealth of the plain are not developed? It is because the people of the mountains cannot reach the wealth of the plains, and the people of the plains cannot avail themselves of the wealth of the mountains, because of the cost of getting from one to the other. This is eliminated by connecting them by great highways. It will increase the fertility of the soil and the richness of the mines and the vast wealth of the forest.

"Upon this great movement rests the happiness and the prosperity of the greatest people on earth, the people who live and who expect to die in Old Kentucky, God bless her."

* * *

## Kentucky's Road Commissioner

Kentucky's Road Commissioner, Robert C. Terrell, who has successfully put into operation the good roads laws of Kentucky and for the past three years has been the head of the road department, was born near Bedford, Trimble County, Kentucky, in 1884. After finishing the common school of that county, he entered the State University of Kentucky and graduated from that institution in 1906, receiving the degree of bachelor of engineering, and was given the master's degree in civil engineering in 1908.

Immediately after receiving his degree in 1906, he took charge of the location of the Duck Fork extension of the Louisville & Atlanta Railway, now a portion of the L. & N. system. In addition to locating the road, Mr. Terrell mapped and opened up a large coal field for the Kentucky River Coal & Coke Co., which was afterwards leased by the Big Hill Coal Company of Pennsylvania. In June, 1907, after completing the work with the Kentucky River Coal & Coke Company, Mr. Terrell was employed by the Arkansas, Louisana & Gulf Railway at Hamburg, Arkansas, as assistant engineer on twenty miles of construction, where he remained until its completion in the summer of 1908.

Through Mr. Terrell's influence with the board of trustees of the State University of Kentucky, there was established the chair of rural and highway engineering in the department of civil engineering of that institution. He was unanimously chosen professor of that chair. He immediately began the campaign to secure not only the undergraduate students in the course, but also arranged to have the practical road builders of the State to take short courses and attend lectures during the winter season. The course grew very popular, and many students were enrolled in both the two and four-year courses for under-graduate students and large numbers of the county road men, as well as the county judges and magistrates matriculated for the lecture courses.

In 1912, when the department of public roads was established by the general assembly, Governor McCreary called Mr. Terrell from the chair of rural and highway engineering of State University of Kentucky and appointed him the first commissioner of public roads of Kentucky. Mr. Terrell assumed his duties on July 1, 1912, and has untiringly given his time and attention to the upbuilding of the road system of the State. Through his efforts, and the showing made by the department prior to the meeting of the general assembly of 1914, was made possible the passage of the State-aid road laws in Kentucky, which provide for inter-county seat system of highways and a five-cent tax, together with the license tax on automobiles to be spent for the construction of the State system of highways, the State paying one-half the cost and the county one-half the cost of such improvement. This law also provides that when the counties vote bond issues and the fund is spent under the supervision of the State road department, the State will pay back one-half the cost. Under the State road fund general, the county and State will spend approximately one and one-half million dollars this season. In addition to that, fourteen counties have voted bonds aggregating nearly three million dollars.



ROBERT C. TERRELL

Mr. Terrell, through his splendid corps of assistants and thorough organization, has had active supervision and charge of the preparation of the plans, specifications and estimates of cost and actual construction of more than one thousand miles of road, and has thoroughly demonstrated to the citizens of the Commonwealth of Kentucky the advantage of having roads constructed on scientific principles, and has made popular the new road laws and has been successful in securing the co-operation of the county officials throughout the State.

Mr. Terrell, when interviewed on the subject, stated he was well pleased with the success of the new road laws, and that a good showing had been made this year, and that fully fifty per cent. more work would be accomplished during the year 1916, as the county officers of nearly every county in the State have already signified their intention of taking their pro rata part of the State-aid fund for the coming year, and many more counties are preparing to vote bond issues.

# Third Canadian and International Road Congress

The Third Canadian and International Good Roads Congress will be held this year at Sohmer Park, Montreal, March 6 to 10, both inclusive, and in spite of the fact that it is being held in "war times," its success is already assured, and it will, without question, be the largest attended road congress ever held in the Dominion of Canada.

This is the official, and the one official road congress held annually in Canada. In this respect, the Dominion has something on this country, which is apparently unable to hold one official annual road congress. The Canadian Road Congress is also in reality an international congress, as has been proven by the attendance of the past two congresses, when very large

delegations were present from the United States, and representatives were in attendance from England, France, Holland, and other European countries, and from a number of South American countries.

The Canadian and International Good Roads Congress, while held under the direct auspices of the Dominion Good Roads Association, is fully recognized by the Dominion Government, which gives active and financial support, and by the governments of every one of the provinces of the Dominion. The various provincial road associations and the motor clubs of Canada also co-operate and take active part, co-operating as they should for the one big annual road congress which, although but two years old, is actually more important and more beneficial in the long run to road improvement in the Dominion than are all of our several so-called "national congresses" here in the States.

The decision to hold the Congress during the present war times was reached by the Executive Committee, which is in charge, for two reasons. The first of these is that, in spite of the war, in which Canada is taking such an active part, the Provincial Governments are all continuing their good roads policies and road construction, and that therefore the interchange of views on road construction, maintenance, and repair should not be interrupted, while the second is tersely and signficantly expressed in the motto, or slogan of the Dominion Good Roads Association, "Goods Roads Are a National Asset and Form Part of the Defense Works of a Nation."

The aims and objects of the Canadian Road Congress need no detailed comment. It is a permanently established organization, since the two congresses which have already been held have been unqualified successes from educational, technical, practical, and business standpoints. They have not, and cannot be considered money-making propositions by even the most critical. Both of the preceding congresses have made some money. This money, however, has been, and is used for the promotion of the succeeding Congress and for promotion and publicity for road improvement throughout the Dominion by the Dominion Good Roads Association. Much good has been accomplished in the Dominion in road construction as a direct and traceable result of the two Congresses, and the manufacturers of and dealers in road equipment and materials in the Dominion freely state that their business has increased rapidly since the first congress was held in Montreal two years ago this spring. This is also a direct benefit to a large number of American manufacturers of road materials and equipment, as all of the largest concerns in this country have either factories, branch houses or their agency connections in Canada, and we are selling much equipment and material to the Provinces, municipalities and contractors of the Dominion.

Better Roads and Streets, therefore, recognizes the Canadian and International Good Roads Congress as the one NATIONAL ROAD CONGRESS of the Dominion of Canada just as it proposes recognizing but one NATIONAL ROAD CONGRESS in the United States, and to which Congresses its support and publicity will be given.

The active propoganda that has been carried on for some years in Canada has converted the people at large to the principle of good roads, and the aim of the various associations and the governments participating, through the Canadian Congress is to disseminate knowledge of the best methods of securing what all are agreed upon should be secured—namely, a network of roads adapted to local needs, but linked up so as to form ultimately, Provincial, National, and International Highway Systems. To this end, the program of the Canadian Congress is being made, year by year, less general and more specific. Instead of vaguely advocating the merits of good roads, the speakers are now generally experts who are peculiarly qualified to speak authoritively upon the various phases of road-building in all their ramifications, finance, legislation, traffic, location, drainage, foundations, wearing surfaces, binders, maintenance, equipment, materials, municipal improvements, bridges, culverts, etc. In addition to talks and papers on the above subjects, prominent citizens of the Dominion and also from the United States and other countries will address the delegates on subjects that are closely allied with the Good Roads Movement.

The secretary of the Congress has advised Better Roads and Streets that, from pledges of co-operation and attendance that he has already received, at least two thousand delegates from every part of the Dominion will be in attendance, the majority of whom will be government ministers, officials, and representatives, county, township, and municipal councillors and road officials, engineers, contractors, manufacturers, of equipment and road and street materials, officials of road organizations and of boards of trade, etc. The indications are that there will be close to 500 guests present from the United States, which will be about 200 more than attended the previous Congresses at Montreal and Toronto.

Sohmer Park, where the Congress will be held this year, is one of the largest and most commodious buildings in Montreal. The ground floor, which covers 25,000 square feet, will be devoted entirely to the Third Annual Good Roads Exhibition, which will be held in connection with the Congress. The Canadian equipment and material manufacturers, and the representatives of products and equipment made in the United States, turn out particularly well at this particular exhibition, and every kind of equipment and material is placed on exhibition. At the first meeting in Montreal, several concerns exhibited what has never been shown in this country—complete road building equipments in operation, such as are sold complete at special prices to municipalities, townships, and counties, these very frequently purchasing the complete outfit on special specification. This year, the equipment used in the construction of streets and sidewalks will also be shown, as will also all accessories and appliances bearing upon the purposes of the Congress.

Above the exhibit hall is a large convention hall, where all sessions will be held. It is well heated and ventilated, and even if the weather is cold, delegates and guests need not fear that there will be a repetition of the North Pole like conditions encountered at the Road Congress in Chicago a year ago.

The officers of the Congress are as follows:—B. Michaud, Deputy Minister of Roads, Province of Quebec, Quebec, President; O. Hezzlewood, President of the Canadian Automobile Federation, Vice President, and George A. McNamee, Secretary and Treasurer of the Dominion Good Roads Association, Secretary and Treasurer. W. A. McLean, Commissioner and Chief Engineer of Highways of the Province of Ontario, Toronto, Ontario, is a member of the Executive Committee.

# Some Data on the Improved Roads of the Philippines

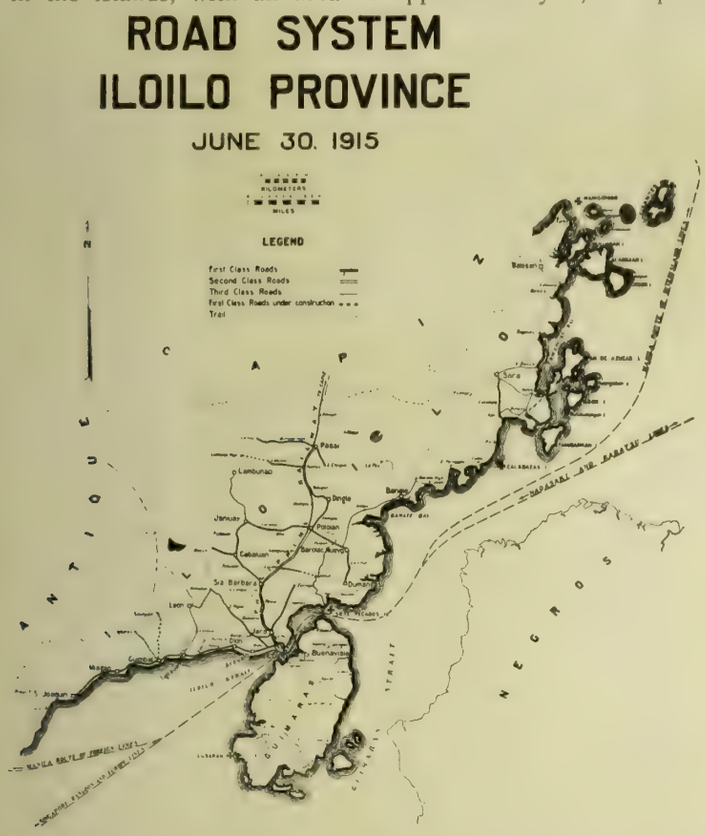
Abstracted by George D. Steele

ALTHOUGH there is a great deal of general interest taken in nearly every section of this country in the improvement of our roads, and the general work that is being done, there is very little, in fact practically no public knowledge as to what has been and is being done in road construction and reconstruction in one of our most important foreign possessions, the Philippine Islands.

During the past year, there has been a great deal of road construction undertaken in the various provinces, and from reports received from the Bureau of Public Works, much real progress has been and is being made. Well designed systems of roads are being worked out, and as rapidly as possible, the roads of these systems are being placed in fine shape. Modern machinery, practically all of which is of American manufacture, shipped from our large road machinery manufacturers of this country, is being used, illustrations of the road work showing that the equipment is substantially the same as is used by our most up-to-date and modern highway departments and road contractors in the United States.

Briefly, in this abstract, it is our intention to show what some of the more important provinces are doing, all of which will be of interest to manufacturers of road machinery, equipment, and materials in this country, as the Philippines are certain to offer a much larger market during the next few years than ever before.

The most important, and naturally the greatest amount of work is being done in Tayabas Province, which is the largest in the islands, with an area of approximately 6,000 square




miles. The isolation of the thirty-two municipalities scattered over this great province renders the operations of government, even with the aid of the telephone and telegraph, necessarily difficult and costly, and makes the construction program for public works an important study. The adoption of a proposed road system, which will ultimately provide a through route to Manila, with feeder roads to the railroad and main trunk highway, seems the only justified procedure, considering several of the islands which comprise the province as separate problems. The towns lying far up the Pacific Coast and those scattered along the Bondoc Peninsula are so small and isolated that water transportation suffices.

In the days of the Spanish regime, there were roads leading from the old capital, Tayabas, to the adjoining towns, and trails across the mountains to the more important towns in other provinces, and also to the more important centers in Tayabas province. The road from Tayabas was paved with boulders and was a much traveled road, Pagbilao being the port for the capital, and this road received all the hauling between these two points. The road from Tayabas to Sariaya was also paved with stones, but beyond the latter city it was only a dirt road. The Tayabas-Lucban Road was also paved and was the main route to Manila. In the lowlands, these roads and trails, for the latter is all that some of them actually were, were wide and well graded, but in the mountain sections the cuts were narrow and the grades were heavy, which is what one would expect where labor was scarce.

The Bondoc Peninsula, then as now, must have depended upon water transportation, for its rugged hills, its many streams and its untamed forest growths have proven a serious obstruction to road construction, even until to-day. The trails from Lucban to Sampaloc and Mauban and to Majayjay were sufficient for pack horses and saddle horses, but no vehicles of any kind could be used on these trails. In fact, in some cases, the grades were so steep that the trail was constructed as a series of steps.

While wheeled vehicles traveled the main roads emanating from the Capital, they were never very plentiful, and the usual mode of locomotion was the saddle horse or hammock. All municipios maintained hammock equipment, and the rates were fixed. To-day, however, a broad highway forty kilometers, or about twenty-five miles in length, extending from the western boundary to the new capital, Lucena, and the Pacific Ocean at Atimonan, rivals the Benguet Road in alignment and setting, and attains an elevation of 1,100 feet. A good road now connects Cotta, Lucena, and Tayabas, and later, an old Spanish road now under reconstruction will lead the traveler high up among the terraced rice fields in the foot-hills of Banahao to the town of Lucban, about fifteen miles from Lucena. Dolores and Canda and Gumaca are open to automobile traffic during the dry season, although the trip is a difficult one. Automobiles and motor trucks are the common means of locomotion and transportation, and many trucks daily transport freight to the railroad. The trip from Manila to Lucena, a distance of about eighty-five miles, requires only about four hours by auto.

All of the completed improved roads in the province are surfaced either with hand broken stone or hard gravel, and in nearly all cases they have a wearing width of about thirteen feet with wide shoulders. The Lucena-Atimonan Road, however, is narrow and has sharp curves and heavy grades. This road was originally built as an army pack trail, but it has become, in recent years, an automobile tourist route, as the automobile has, to a great extent, supplanted the pack mule.

Marinduque has already been nearly half encircled by a first-class, well-constructed roadway, and additions are being made each year. From Boac, the capital of the sub-province of Marinduque, the road is completed only a short distance north to Mogpog, but to the south, the road has been completed through Gasan to Buenavista, which is an important health resort with hot springs of great medicinal value. The remainder of the circuit of the island is merely a trail from Buenavista through Torrijos to Santa Cruz. Altogether there are 133




kilometers of first-class road in Tayabas, of which thirty-four kilometers are in Marinduque.

A recent project in road building will extend the road down the western coast of the Bondoc Peninsula, thereby affording several isolated sections the means of communication with the railroad. Another important improvement is providing the now isolated seacoast towns with the necessary roads to the landings, and this work is being pushed forward just as rapidly

as the available funds will permit, as every effort is being made to facilitate the movement of the products of the province to the various markets.

About seventy-five per cent. of the labor that has been employed in the construction of roads in Tayabas, since 1908, has been supplied by adjoining provinces, and in some cases by provinces as far distant as Ilocos Sur. Therefore, it is but natural that the cost of labor is high, and that the expenditures for road construction and all other public works improvements should exceed those for similar projects in more favored and better located provinces. On the other hand, however, the labor is of an excellent quality, so that most of the work compares very favorably in quality and cost with the best that is found on the islands.

All of the first class roads of the province are maintained by the district engineer under what is termed the "Isloated Caminero System," which has been found effectual and fairly satisfactory. The only objection to this, or to any other feasible system, is its cost, the following being average figures paid on the island. In these figures, the peso is worth fifty cents in our money, and is equal to fifty centavos. Common labor is paid eighty centavos per day, capataces from one and one-half to two and one-quarter pesos per day, and materials on a like scale. The appropriation for first class road maintenance in 1915 was 60,400 pesos, of which 7,000 pesos was for Marinduque.

Second class roads and trails are maintained under the gang system, as an effort is made to keep these roads open to traffic and to improve them just as rapidly as the limited funds will permit. In 1915, there were but 4,000 pesos available for this work.

Of the road construction that is under way at present, the most important project is the road from Tayabas to Lucban, the entire territory around the latter city being a very productive and important one. The heavy grades on the old roads had, however, made the use of carts impracticable, and this practically isolated this section. Work is now being pushed rapidly on this road, the curves and grades are being properly constructed according to the best practice in modern road building, and the old Spanish road is rapidly being converted into a modern highway. The surfacing material for the road is being broken by hand, for which the stone breakers receive one and one-half pesos per cubic meter, which is a little more than a cubic yard. Stone for this purpose is very plentiful. Most of that used is taken from the cuts that are being made to reduce the grades, and it is all of an igneous character and very hard to break up. An idea of the character of the work involved may be obtained from the fact that over 2,000 cubic meters of earth, rock, and boulders were taken out of a cut that was only 200 meters, or about 650 feet long. The highest point on this road is fifteen hundred feet above the sea. The total cost of the project will be about 100,000 pesos, or an average of 9,000 pesos per kilometer. Much remains to be done in road construction in the province, and the lack of adequate funds for this purpose alone prevents the more rapid realization of the completion of the entire proposed road system.

Considerable progress has been made in the construction of modern bridges and culverts, and this work will be continued annually until these structures will be as good as those found anywhere in the United States. There are 312 bridges and culverts in the entire province, of which 105 are of the old Spanish type structures. The remainder are of modern construction, divided as follows: five steel bridges with a total span of 150 meters, or about 485 feet; two concrete arch bridges with a total span of about thirty meters, or about ninety-seven feet, and twenty-four slab and girder bridges with a total span of 336 meters, or about 1,092 feet. The remainder of these structures are box and pipe culverts having an aggregate span of 325 meters, or about 1,056 feet. It is well worthy of mention that all of these old Spanish structures are of the arched type, and in almost every instance the larger structures are in excellent condition, although nothing has been expended for repairs in sixty years. These bridges are all rubble masonry laid in lime mortar, an examination of which this year shows that the lime used was of a very high quality and that those who built the structures had expert knowledge of its use.

### ROAD WORK IN ILOILO PROVINCE.

The province of Iloilo is about 170 kilometers long and sixty kilometers wide, covering an area of approximately 2,000 square miles. It contains twenty-two municipalities, having a total population of about 500,000. The Philippine Railway, running north and south from Iloilo to Capiz, practically divides the province in halves, and furnishes the main outlet for traffic. This railroad is fed by numerous first class highways, as will be noted on the map of the road system of the province. These roads are selected to cross the railroad at practically all of the more important stations along the line. This comprehensive system of highways, furnishing ample and economical means of transportation, has resulted in making the Province of Iloilo the best and most attractive agricultural locality in the Philippine Islands, and traffic reports that are kept of the products hauled over these roads show that with the improvement of the highways, there is a very substantial increase in the local production of all staple articles.

On June 1, 1915, the Province of Iloilo had 162.3 kilometers of first class roads, all of which has been either newly constructed or rebuilt under the direction and supervision of the Bureau of Public Works. The most important road is that running from Iloilo to San Joaquin, and known as the coast road. This road is 52.8 kilometers in length, of which 21 kilometers are strictly first class road. Four modern bridges have been built along this road, two of them being of steel and the other two of reinforced concrete. Many small bridges and culverts of modern construction have also been constructed.

The longest continuous stretch of first class highway in the province, however, runs north from Jaro, paralleling the railroad generally, through a beautiful and most fertile valley. The length of this road is sixty-five kilometers. There is a second class road between Pototan and Dingle which is now being reconstructed, and from Dingle to Tabugon, a first class road five kilometers in length has been built. The former road, when completed, will add an additional stretch of thirteen kilometers to the continuous section of road referred to above.

South of Pototan, the Bureau of Public Works is building a new road at Lucena, which will be eight kilometers in length, and which will open up for development, an entirely new section of the province. The entire road was graded in 1915, and the surfacing will be completed during the present winter. The Bureau is also completing another new road, which also opens up a new section, north of Pototan, this improvement being seventeen kilometers in length. Both of these roads are being built under Insular allotments.

### ANTIQUE PROVINCE.

Antique Province adjoins Iloilo on the west, and has 52.5 kilometers of first class road. Construction has been under way all year on the San Jose-North road, but progress has been rather slow, owing to the difficulty of securing laborers. During the dry seasons, the people will willingly work on the roads, but as soon as the heavy rains come, they desert this form of employment and turn to their fields. Along what is known as the South Road, from San Jose to Dao, the only route was formerly along the beach, but a new road twenty-one kilometers in length is being constructed. All of the subgrade work was completed this year, and gravel surfacing for a distance of seventeen kilometers is completed. The costs on this part of the work are interesting in comparison with the costs of similar construction in this country. Six men at forty centavos each per day, working under a capataz, or foreman, at fifty centavos per day, can screen six cubic meters of gravel in one day, thus making the average cost per cubic meter, ready to haul, forty-eight and one-third centavos. The gravel pit is about one kilometer from the road, and the average haul is three and two-tenths kilometers. Twenty men at forty centavos and one capataz at fifty centavos per day can haul by tramway, eighteen cubic meters of gravel from the pit to the road in one day. This makes the cost of the gravel ready to spread on the road forty-seven centavos per cubic meter, which cost does not include the depreciation or equipment. The gravel is ordinary river gravel of average hardness.

Throughout the province, much attention is paid to the planting of trees along all first class roads, this being a part of the construction work. All dead trees are removed and re-

placed, and the trees which have been planted and growing are pruned at the proper time.

In addition to this road work in the principal provinces of the Philippines, there has been much other road work in the smaller provinces, and sentiment is generally very strong in favor of the improvement of the roads throughout all parts of the islands.

# Michigan

## Announcement of the Second Annual Short Course in Highway Engineering at the University of Michigan

The University of Michigan announces its second annual short course in Highway Engineering to be given in Ann Arbor, Michigan, February 21 to 25 inclusive, 1916.

Instruction will be given in road building by members of the faculty of the College of Engineering in co-operation with the Michigan State Highway Department. Additional instruction will be provided for by special lectures given by men noted in their particular line of work. These lectures are listed as follows:

"The Economic Design of Highways with Reference to Traffic," by Arthur H. Blanchard, Professor of Highway Engineering, Columbia University.

"Bituminous Surface Treatment for Water-Bound Macadam and Gravel Roads," by Chas. F. Reeve, Chief Chemist of the Office of Public Roads, Washington, D. C.

"The Maintenance of Earth Roads," by W. S. Gearhart, State Highway Engineer of Kansas.

"Specifications and Contracts," by H. K. Vedder, Professor of Civil Engineering, Michigan Agricultural College.

"The Duty of the County Road Commissioners," by Wm. Kelly, Chairman of the Dickinson County Road Commission.

"The Highway Engineer as a Public Servant," by Ira O. Baker, Professor of Civil Engineering, University of Illinois.

"Road Maintenance," by Frank F. Rogers, Michigan State Highway Commissioner.

There will be one or two other additional special lectures given, arrangements for which have not been completed. The program will also contain numerous papers given by practicing Highway Engineers and Highway Commissioners of Michigan. The work is designed primarily to be of interest to the Highway Engineers and Road Commissioners in the State of Michigan. The subjects treated will be given largely from the viewpoint of Michigan conditions.

The course will be conducted practically along the same lines as last year. That is, the forenoon of each day will be devoted largely to class-room work. The afternoon work will be conducted in two divisions. Those desirous of investigating highway materials of construction in the laboratory will be formed in one division, while the other division will have the opportunity of hearing and discussing papers on highway construction and maintenance. The evenings will be given over entirely to the special lectures.

Because of the limited time available for this course, and on account of the large number of subjects to be considered, no place on the program has been given to representatives of companies dealing in highway materials or equipment or of other commercial interests, and no exhibits of machinery and materials have been invited. It is hoped that the absence of these features not only will result in a saving of time to those in attendance, but will also secure for the short course the same favorable opportunity for free and open discussion that is enjoyed in the ordinary courses of study at the University.

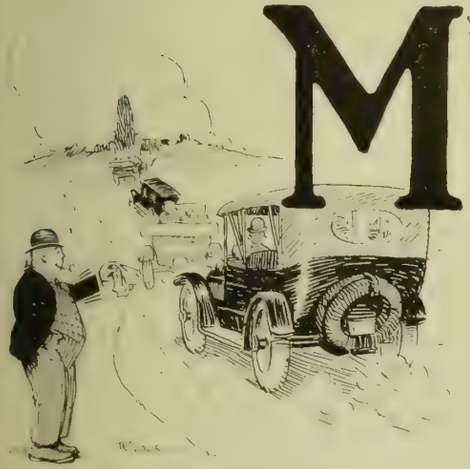
This short course will be open to engineers, highway commissioners, and others engaged or interested in the improvement of the roads in Michigan, or elsewhere. There will be no laboratory fees or charges of any kind connected with the course.

A special announcement, containing a complete program of the work, will be issued about January 1. Requests for copies of same should be addressed to John J. Cox, Assistant Professor of Civil Engineering, University of Michigan, Ann Arbor.

# Road Pickings—No. 12

By William Sport

In which Dennis makes some observations regarding the need of diplomacy and a proper regard for local pride and patronage.



MY DEAR CASEY:

Well, Casey, th' road buildin' season is over at last, th' final istymates all made up an' th' conthractors all stharted fer Palm Beach, Florrida, in their bran' new sivin passenger motor cars over th' Dixie Highways. An' nothin' fer your cousin Dinnis to do but to go back to th' farrm an' feed th' cows an' chickens 'till nixt road buildin' season comes 'round. Oi think that nixt year Oi'll have to resign frrom th' job av commissioner an' go conthractin' mysilf loike my frind Jim Dugan thot used to be county auditor av Sullyvan County, Iowa.

You niver knew Jim, did you? He is wan grreat man, Casey, an' wan av th' most gifted orrytors av th' counthry.

Oi'll niver fergit th' spheech he made at wan av th' big road convintions a thryin' to indooce thim to to hold th' nixt convintion in his Sthate.

Yes, sir, Casey, if Oi could talk loike Jim, Oi'd be afther runnin' agin Bryan fer th' Dimmycratic nomination fer Prisident nixt year.

Th' only throuble with Dugan was thot he didn't always make his spheeches at th' roight toime. At th' road convintion Oi was afther tellin' you about he waited 'till th' ind av wan av th' long sessions whin they had been havin' a lot av argumints an' iv'rywan was warned up fer a good foight an' thin he invited thim in th' name av Des Moines or Sioux Cithy or Dubuque or Council Bluffs or Cedar Rapids or Davenporrt or Waterloo or Iowa Cithy or Oskaloosa or ennywhere else in th' Sthate to come to thot cithy with their nixt convintion.

Th' nixt spheaker who was a pullin' fer Peoria, Illinois, sez something about "our gifted frind, Gatlin' Gun Jim," an' th' sobry kew sthuck.

Thin again at th' annual convintions av th' Iowa commissioners association it was Jim that was always th' leadin' spheaker. Yes, sir, Casey, he had th' roight idea; all he had to do was to begin. "Honored gintlemen, av this most grrand an' glorious an' richest an' most prrogrissive Sthate av our grrand an' glorious an' rich an' prosperous counthry," an' re-

peat thot about iv'ry three minutes an' they'd listen to him as long as his wind would hold out.

No, Casey, none av thim iver remimbered what it was he was talkin' to thim about, they didn't need to; all they knew was thot they was honored gintlemen frrom th' grrandest an'




**Th' only throuble with Dugan was that he didn't always make his speeches at th' roight toime**

richest an' most glorious an' prrogressive Sthate in th' Union thot had iv'ry other place beat to a frazzle in iv'rything frrom roads to pineapples an' polar bears.

Yis, Jim was a grreat orrytor an' a grreat orrganizer too. It was him thot orrganized th' Society fer Road an' Highway Improvmint, Construction an' Repair av Sullyvan County an' th' Sthate av Iowa thot they talked about so much a few years ago.

An', Casey, Jim was roight whin he sez thot thot orrganization was th' grreatest an' grrandest an' most prrogrissive an'




**All they knew was thot they was honored gintlemen.**

prrofitable association in th' whole counthry,—at least it was th' most prrofitable fer Jim Dugan. He collected tin dollars apiece dues frrom all av th' mimbers an' got enough money to set himsilf up in th' conthractin business with all av th' latest road buildin' machinery.

Thin with th' backin' av th' insphired association he got th' people to vote a bond issue av wan million dollars fer roads an' thin awarded all av th' conthracts to himsilf.

Frank Maguire, th' Des Moines conthractors' equipmint man sez to me th' last toime Oi seen him, "Dinnis," he sez, "kape an eye on Sullyvan County, Iowa. If Dugan's voice doesn't give out on him they'll have more miles av paved roads than inny other county in th' counthry." He sez, "Last week it was thot they voted their third bond issue av wan million dollars an' Dugan got all av th' conthracts. Oi've just sold him wan bran' new asfalt plant, sivin cimint mixers, foive steam rollers, three sivinty-ton shovels, sivinteen motor thrucks, thirty-foive dump wagons an' a lot av grraders an' oilers an' smaller equipmint."

"Shure," Oi sez, "An' couldn't you slip in a few Mallet locomotives an' wan av thim ladder dredges on th' side?"




**"An' couldn't you slip in a few Mallet locomotives?"**

"Oi don't know," he sez, "but it's him thot's figgerin' on a sthandard guage railway fer a sivinteen-mile brrick conthract."

Well, ennyhow, Frank sez thot there's only wan throuble about Jim havin' so minny road conthracts; he doesn't have enny toime fer sthreet pavin'.

Y' see th' commercial club av Connersville, th' county seat, sort av caught th' road buildin' bug an' got to figgerin' on pavin' a few av their main sthreets to connect up with th' county system. They was all set an' ready to call fer bids whin Jim goes




**Frank sez thot if he hadn't hustled Donovan onto a thrain . . . . he'd have lost th' sale.**

arround an' tells thim thot it wasn't enny use. He sez he was too busy to take enny more conthracts fer siveral years.

Frank sez he was up in Connersville an' met Donovan, th' prisident av th' commercial club at th' hotel. Donovan told him th' whole sthory, an' accordin' to Frank, he acted verry disappointed at not havin' th' scheme go through.

"An' why don't you git young Tom Flynn frrom Barryville over in th' nixt county to do th' pavin'," sez Maguire. "He is a good conthractor, has lots av machinery an' he hasn't many conthracts this year so you can git him to do th' worrk chape."

"An' phwat are you thinkin' about, Mr. Maguire," sez Donovan, "You don't suppose fer wan minnit thot we'd be afther lettin' enny conthracts to ennywan excipt our own conthractor, do you?"

Frank sez thot if he hadn't hustled Donovan onto a thrain an' taken him fer a week's insphiction thrip in Omaha he'd have lost th' sale av all av thot machinery to Jim Dugan, just on account av thot wan frindly suggestion.

So you see, Casey, it isn't road commissioners thot's th' only wans thot have to be good politicians.

# Asphalt Repair Plants for Small Cities

By George D. Steele

STREETS surfaced with sheet asphalt were, for many years considered only to be enjoyed by the large cities and the rich cities—cities which could, owing to their high valuations and consequent abundant taxes, afford to lay the very best types of surfaces. These large and rich cities, as a general rule, were also able to install large, complicated and expensive repair plants after the streets had been laid a few years, in order to take proper care of the repairs made necessary by the thousands of street openings which are to be contended with in every large city, and also of the natural wearing out of the surface under traffic, etc. And as these plants, erected by such cities as New York, Chicago, Pittsburgh, San Francisco, and others, were large, complicated, and expensive, the impression grew that any plant required for the repair and maintenance of sheet asphalt streets must be so complicated and expensive that it was out of the reach of the smaller city and the town. This impression was, from the very beginning, helped along materially by the promotors of other types of surfacing for city streets taking advantage of this condition, and when in competition with asphalt, the wily promotor would only have to say, "Mr. Jones, have you taken into consideration that, if you have 100,000 square yards of sheet asphalt in Jonesville, you will have to plunk down in hard, cold cash at least $20,000 for the erection of an asphalt repair plant to make your repairs, to say nothing of the valuable ground that you will have to occupy, and possibly purchase, on which to erect this plant, and to provide storage for your materials, wagons, stables, etc.?" Mr. Jones, or any other city engineer or street paving official usually sat up and took notice. The wily promotor saw immediately that he had fired a solid shot from a forty-two centimeter mortar, and then followed it up with a statement something like this: "Now Mr. Jones, I am not asking you to take my word for it, but you can write to the street officials in New York, Pittsburgh, Chicago, etc., and they will all tell you that their asphalt plants are expensive." Care was always taken to name cities which had expensive plants, following it up with the remark that "While your plant need not be nearly so large as the one in Manhattan, you will have to have your boilers and engines, or your motors, your conveyors, the furnaces, dryers, and all that kind of equipment, and a plant for repairing 100,000 square yards of sheet asphalt will cost about half as much as a plant necessary for a city having 500,000 square yards of sheet asphalt."

This has been done in hundreds of cases, and the use of such so-called "information" was indulged in particularly often during the summer of 1915 throughout Pennsylvania, Maryland, Ohio, West Virginia, Indiana, and Illinois, as well as most of the Middle Atlantic States, by the interests who have been fighting for street surfaces in towns of from 15,000 to 75,000 population, in opposition to sheet asphalt. And in a great many cases, the opposing interests have been able to get away with it, eliminating sheet asphalt from the paving program, and having their own particular material substituted instead, where in the first place the city authorities had been fully decided on the subject of surfacing, and had intended using sheet asphalt. The attention of BETTER ROADS AND STREETS has been called to this condition many times during the past paving season, and proposes in succeeding issues to present to our readers, a large number of which are much interested in this subject, facts and figures showing the initial cost of plants, costs of operation and other data for cities of all sizes. Every known type and make of plant will be discussed and described impartially, giving costs of the installation complete, and such other data as it has been possible and will be possible to obtain. These will be actual installations in cities and towns in all parts of the country, giving promise of making it one of the most interesting and instructive series of articles on a type of modern street pavement that has ever been compiled and published. All figures will be authentic and will be furnished by the city or town using the plant, and by the concern which manufactured or built the plant.

The illustration of the plant which we show herewith is an interesting one, and easily refutes the claim that asphalt streets can only be cared for and maintained by the installation of an expensive repair plant. The plant is a "home-made" one, but gives perfect satisfaction, being in use in western New York State, and it did not cost $5,000 or $7,500 or $10,000 either. Neither is it a "costly" stationary plant, as it will readily be seen that it is distinctly portable. So much so, in fact, that a one-horse team could easily handle it with the aid of a couple of able-bodied men. And the cost? Well, it may be a shame to give this out, but we have to. The figures were given to us



to give out, so we will let it be known that this "Portable Asphalt Repair Plant" for municipality or contractor, cost just ONE HUNDRED AND SIXTY DOLLARS in United States money. And the plant is capable of easily and properly furnishing the material to keep in repair 50,000 square yards of sheet asphalt in any town or city in the United States.

It will be noted that the plant is a complete one—operated by hand-power, but complete and efficient just the same. It includes even the pouring pot, rakes, tamper, smoothing irons, etc. The actual cost of the plant as shown, not including the brick columns which support the working unit on the left, was as follows:

| | |
|---|---|
| One Sheet Steel Pan | $60.00 |
| One 100-gallon Heating Kettle | 85.00 |
| Small Tools, Including Tamper, Rakes, Pouring Pot, Smoothing Irons, etc. | 15.00 |
| Total Cost of Plant | $160.00 |

This plant is not a toy, but is practical in every way. The binder and the surface material are mixed by hand, one man being able to perform this operation for the binder and another for the topping. All street openings made in a city with 50,000 square yards of sheet asphalt pavement are promptly repaired, and they are kept in better shape than the streets in some cities which have plants costing ten times as much as this plant cost. When repair work is to be done, the drying and mixing unit of the plant can be loaded on a wagon, the kettle hitched on behind, the tools and bricks for supports or columns loaded on and hauled to the site. Material is assumed to have been delivered there, and in half an hour the plant is set up at any convenient place. A hose turned into the pan for a few minutes when the repair work has been completed will cool the steel enough to again load it on the wagon, so that it need never be left out, necessitating a second trip to bring it back to the headquarters of the Municipal Asphalt Repair Plant. There are no large charges for depreciation in this plant. Neither is there any heavy over-head charge for its operation. No engineer is required, and the city that is using it congratulates itself that it does not have to employ a superintendent at about $150 per month to work a few days out of each week in the summer and the same number of days each month in winter.

This home-made, but efficient plant is shown in this article so that it can be contrasted with the many types of plants which will be illustrated and described in subsequent articles, thereby clearly illustrating that no city need be afraid to lay sheet asphalt streets because enormous sums would have to be expended for repair plants.

*(To Be Continued in February.)*

# New Jersey Wants $53,000,000 for State Roads

IF New Jersey had the money and the legislature had the inclination to appropriate it, it would cost a total of $53,000,000 to place the roads of the State in proper condition. This figure was decided upon by Colonel Edwin A. Stevens, Commissioner of Public Roads of the State of New Jersey, after a careful survey of the roads and their respective conditions throughout the entire State, and which he transmitted in a report the latter part of November to Governor Fielder. The important parts of this report will be found in the following paragraphs, which have been abstracted from this report:

The State must absolutely do something to meet the demands of present-day travel, and the report dwells particularly upon two main points, namely:

1. The inadequacy of the present road system.
2. The ever-increasing necessity of adopting a policy that will meet the demands of travel. This, in turn, would entail a survey of the roads of the State and a thorough and uniform system of accounting to show not only the moneys expended, but also the services rendered. Colonel Stevens is also firmly convinced that to obtain the best results a permanent tenure of office for the road officials, engineers, and forces is necessary.

The problem confronting the State is made particularly acute by the rapidly increasing number of automobiles. In 1912, there was one automobile in New Jersey for every fifty inhabitants. In 1913, there was one automobile for every forty-six inhabitants. In 1914, there was one automobile for every forty inhabitants; while in 1915, the number has increased to one car for every thirty-two inhabitants. This latter figure works out that there is one automobile for every mile of country road in the entire State, but not including the mileage of roads running through cities as city streets. But there is room for still further growth, in the opinion of Colonel Stevens, and he estimates that the motor-vehicle output and registration can be increased from the present figure of about 150,000 cars to between 600,000 and 800,000 in a comparatively few years.

Remarking upon the heavy burdens that have been imposed upon the local authorities in the way of maintenance, it is shown that the increase in receipts from motor vehicles has been in no wise proportionate to the increase in demand for assistance from the various counties. Five years ago, from one-third to one-half of the amount needed to keep the main lines of traffic in repair could be met out of the motor-vehicle license fund. But in 1915, despite an unexpectedly large increase in receipts, it has been impossible to provide more than twenty per cent. of the money that should have been spent for repairs. And reducing this problem to figures, Colonel Stevens said it could be proved, as a fair average, that an automobile traveling six thousand miles a year over the roads, will inflict damage amounting to from thirty to fifty dollars to those roads, but still only pays a license fee of $7.50. For an ordinary two-horse team, it is estimated that the damage inflicted upon the roads will not cost more than eight dollars to replace.

"It is, therefore, easy to see that the greater the growth of motor-vehicle traffic and the larger the receipts therefrom, the greater will be the demand upon the various counties for repair work, and the lesser the proportional part thereof which can be contributed from the motor-vehicle fund. The situation calls for foresight and careful business management, as well as for a policy which shall be consistently followed.

"We are ill prepared to meet the needs of the situation. We have no exact knowledge of the travel on our roads, their mileage, the cost of repair, nor of the portion thereof that has been improved. This very necessary information cannot be systematically gathered under our legislation as it is to-day. What little has been done in this way has been incidental to other work, and is too spasmodic in character to furnish any basis for design. All we know with certainty is that 1,988 miles of roads of the State have been improved with State aid. Our total road mileage, exclusive of streets, is probably about fifteen thousand miles."

In showing that repair work consumes twice as much of the State funds as does the construction of the roads, Colonel Stevens cited several faults in the present legislation which controls road construction and maintenance. He said it is evident that as both mileage and traffic show further increases, the cost of repairs, and the ratio of this cost to the total road expenses, must continue to increase. Concerning some of the inconsistencies of the present system, he said:

"The State did act, as interpreted, to make it consistent with the Requisition Act, which provides that no allotment can be made to a county from the motor-vehicle fund until the money has actually been collected. It directs that motor-vehicle moneys be spent on the repair of the most important improved roads. It also provides that help can be given for the resurfacing and extraordinary repair of roads, which to-day is our most important work, only by setting aside by allotment the State's share of the cost of this work at the time the plans and specifications therefor are approved.

"This work should all be arranged for in the early months of the year, so that it can be commenced toward the end of March or the beginning of April, according to the condition of the weather. There is, however, at that time of the year, but little money available in the motor-vehicle fund, and allotments cannot be made to provide for more than a fraction of the work until toward the end of spring.

"After the approval of the specifications, it is necessary to advertise for three weeks, so that this, our most important work, cannot be started until the season of the heaviest traffic has arrived, to the great inconvenience of the public using the roads, and also at a very considerable increase in expense."

Colonel Stevens then stated that the subdivision of road moneys into various funds creates, in the majority of cases, inequalities and difficulties in administration that have in the past resulted in delay, loss, and much general disappointment. He also expressed the hope that these, as well as some other defects, would be met and remedied by the commission which was appointed by the last legislature to revise not only the legislation, but also the general road policy of the State.

"Remedial legislation must be hastened," he stated, "on a realization that our public roads constitute a transportation system of the greatest vital importance to the State, in addition to a very considerable past investment and much larger expenditures in the future, not only for the construction of additional mileage of roads, but also for their maintenance after they are constructed. Their importance is such that we cannot do without them. Their administration has become a business, and we must handle it in a business-like manner, just as any other business would be handled.

"For this purpose, we must put a body of experts on the job and give them the powers needed to get results and judge them by these results. We cannot afford any amateur trifling in our engineering, nor any political interference in the administration of our roads. No legislation will satisfactorily solve our difficulties which ignores these principles."

# Mississippi County, Arkansas, Will Build Concrete Roads

As this issue of Better Roads and Streets reaches our readers, one of the largest, if not the largest, concrete-road projects yet attempted in this country, will be placed under actual construction. The improvement consists of the construction of twenty-eight and one-half miles of single-course concrete pavement in Mississippi County, Arkansas, and will be undertaken by the Osceola & Little River Road Improvement District Number One of Mississippi County. The work will be financed by the road improvement district, and will be in charge of and under the direct supervision of the Commissioners of the district, who have their office at Osceola. Contracts for the improvement were awarded in December, and

the work is to be started early in January, 1916. It is stipulated that all construction work will be completed not later than January 1, 1917. This means that the work will have to be pushed by the contractors, who will be compelled to employ a large number of men and to make use of the most modern and approved equipment. There will be a total of 159,000 square yards of concrete to be laid, and to do this within a year will be no small task.

The work is divided into four sections, which are as follows:

| Road | No. 1 | No. 2 | No. 3 | No. 4 | No. 5 | No. 6 |
|---|---|---|---|---|---|---|
| Sec. No. 1 | 4.00 | 3.00 | | | | |
| Sec. No. 2 | 3.25 | | 2.00 | 3.00 | | |
| Sec. No. 3 | 6.75 | | | | | |
| Sec. No. 4 | 1.25 | | | | 2.25 | 3.00 |
| Totals | 15.25 | 3.00 | 2.00 | 3.00 | 2.25 | 3.00 |

The approximate quantities in each of these sections are as follows:

| | No. 1 | No. 2 | No. 3 | No. 4 |
|---|---|---|---|---|
| Miles of road | 7.00 | 8.25 | 6.75 | 6.50 |
| Cubic yards of earth excavation to be placed in embankment | 42,506 | 67,096 | 38,866 | 48,594 |
| Cubic yards of earth excavation not to be placed in embankment | 13,671 | 28,812 | 3,887 | 4,378 |
| Square yards of silica or crushed stone shoulders | 15,840 | 29,040 | 23,760 | 22,880 |
| Square yards of concrete paving | 45,760 | 43,560 | 35,640 | 34,320 |
| Steel bridges to be constr't'd | 3 | 3 | 1 | 2 |

The roads that will be built in this Improvement District will have a graded top width of thirty feet where the center fills are less than one and one-half feet, and the same top width in cuts. Where the center fills are more than one and one-half feet, the graded top width will be twenty-two feet. Along all center fills of more than one and one-half feet, a four-foot berm will be provided between the roadbed and the side ditches. This berm will have a slope of one inch to the foot toward the side ditch.

The concrete pavement will be constructed nine feet in width on what are known as the narrow-gauge roads, which are the narrow roads which have principally one-way traffic in one direction in the morning and in the opposite direction in the afternoon or evening. This pavement will be seven inches thick at the center and six inches at the sides. On the wider and more important, or broad-gauge, roads, the concrete pavement will be constructed fifteen feet wide, and will be eight inches thick at the center and six inches at the sides.

Transverse joints, perpendicular to the surface of the pavement, will be provided at intervals of thirty feet throughout the entire length of the pavement. The specifications provide that these joints shall not be less than one-quarter inch and not more than three-eighths inch in thickness, and that they shall be protected with soft steel joint protection plates two and one-half inches in depth and three-sixteenths inch in average thickness. The joint filler shall consist of prepared felt or similar approved material one-quarter inch thick. On each side of the concrete pavement there will be constructed a silica or crushed-stone shoulder three feet in width.

Best quality coarse and fine aggregate will be used, this being obtained locally wherever this is possible. The coarse aggregate will be clean crushed stone from which all dust has been screened, or clean washed gravel. The fine aggregate will be clean washed sand which must be free from lignite. The coarse aggregate will pass a one-and-one-half-inch ring and be retained on a one-quarter-inch ring. A 2:3:6 mix will be used in the construction of the concrete pavement.

Pride & Fairley, Osceola, Arkansas, are the engineers for the Osceola & Little River Improvement District Number One, and prepared the plans and specifications for this work. They will also have supervision over the construction work and the testing of all materials entering into the construction of the roads.

# Determinations Regarding Pavements in New Jersey

DURING the past year, an important series of experiments has been conducted in New Jersey by R. B. Gage, chief chemist of the State Road Commission, in the endeavor to find which types were the best to construct under different conditions, and for varying conditions of traffic. These determinations are set forth in a report just completed by Mr. Gage, and it is given herewith in complete form.

Most of the pavements now specified in the State Specifications, which a few years ago were considered to be in the experimental state, have now been in use for a sufficient length of time to enable us to judge their efficiency and durability when constructed in different ways and subjected to different conditions of climate and travel. The premature failures which have occurred during this time, particularly in the bituminous concrete pavements, have been mostly local, and limited in extent, yet they have shown quite plainly what the danger elements are from which the pavements must be protected during construction and subsequent use.

The following facts have been definitely established:

1. Any bituminous concrete pavement of either the hot or cold mixed grade, when properly constructed and laid on a suitable and well-drained base, will last at least five years with very little repair, and from ten to fifteen years longer if the pavement is properly repaired and maintained.

2. These pavements cannot be properly constructed by novices, or even by experienced contractors unless they have the proper equipment and necessary financial resources.

3. That it is false economy to award contracts to contractors who have not had the necessary experience, or who have not the required equipment and financial resources.

4. That hot-mixed bituminous pavements are more difficult to construct than those by the cold-mixed method.

5. That the life of any bituminous concrete pavement is limited unless it is properly constructed.

6. That hot-mixed bituminous pavements cannot be repaired as cheaply or conveniently as those of the cold-mixed method.

7. When properly constructed, a hot-mixed bituminous concrete pavement will, on the average, require less repairing during the first five years of its life than will a pavement of the cold-mixed type.

8. That a comparatively soft bituminous pavement, having a low tensile strength, is superior to a brittle pavement with a high tensile strength.

9. That over ninety per cent. of the early failures in bituminous pavements have been caused by faulty construction, unstable or improperly drained bases, and not by the use of inferior materials.

10. That a well-drained old macadam road, if scarified and redressed with a layer of one-and-one-half-inch stone, can be kept in a satisfactory condition, even when subjected to fairly heavy traffic, by frequently coating the surface with a liquid bituminous binder.

11. The cost of maintaining in proper condition such a repaired macadam road, is not much in excess of the interest charge on the cost of an expensive bituminous concrete surface.

12. A Portland cement concrete road, if properly constructed, would seem to need but little repairing during the first five years of its life.

13. Such a pavement makes a very satisfactory surface for automobile traffic, and is not as slippery in winter as a bituminous concrete pavement.

14. After such a pavement is no longer suitable as a surface, it can be used as a base for a bituminous or a block pavement.

15. When a pavement is to be subjected to much automobile traffic, the probable difference in durability between a Portland cement concrete road and a macadam road would seem to indicate that the former is more economical, even if the initial cost is somewhat higher.

16. If a Portland cement concrete road is not uniform in composition, it is prone to develop pot holes. Pavements of this type are exceedingly hard to repair satisfactorily.

17. The sub-foundation for a Portland cement concrete road should be more carefully prepared than for any other kind of pavement surface.

18. The application of a lignin binder to a gravel surface greatly prolongs the life of such a road. It prevents it raveling during the dry season, or becoming soft and impassable when the frost is leaving the ground.

The importance of accurate traffic data in judging the wearing qualities and the durability of different types of pavements cannot be over-estimated.

Undoubtedly there will be some who will take exception to some of the findings as enumerated and contained in this report. It must, however, be taken into consideration that these findings and determinations do not, and are not intended to, cover paving in all parts of the country, but that they were made up from tests and observations on the roads within the State of New Jersey, and in connection with the materials that have been sold for use on the roads of that State. It must be admitted, however, that there is a decided preference shown for certain materials, but it is also a fact that these materials have, even under the heavy traffic to which the roads are subjected, made a most creditable showing, and this would, therefore, seem to warrant such prefenence. The repair and maintenance charges on the types of roads referred to have been low, and they are generally in excellent condition throughout the entire year. The investigations that have been under way have been so helpful to the New Jersey State Roads Commission, that they will not only be continued during the coming year, but the examinations and investigations will be broadened out and expanded to cover a far greater scope and mileage.

# Wood Block Pavements

By F. W. Willenburg

THE modern city thoroughfares of the highest class are not the result of the thought and study of any one man, while, on the contrary, they are the result of many years of study, experimentation, success, and failure. Large numbers of engineers and non-engineers, superintendents, inspectors, foremen, and even laborers, have contributed to the degree of success which characterizes the modern pavements of to-day. Millions of dollars have been expended, most of it without result, in bringing the modern city pavement to the high standard in which it is to-day in this country.

All of us are more or less familiar with the many forms and types of street pavements which have been handed down to us from one constructive generation to another in the last century, but more particularly in the last fifty years, and we have seen each of these replaced by its improved-upon successor, until to-day we come to what is being recognized as the highest stage of perfection in the art of street paving. This is the creosoted wood paving block which is being so generally used on the heaviest traffic streets in large and small cities in every part of this country.

Wood, in one form or another, has been used for a great many years as a paving material. The first instance where it is authentically credited with having been used as a surfacing material for streets, is said to have been in Russia, where rough and crude blocks were laid on some of the streets several centuries ago. Wood, as a paving material, so far as is known, was first used in the United States about seventy years ago. The paving blocks as used at that time in this country were roughly cut to a cylindrical form and laid in such a manner that large and very unequal interstices were left between the blocks. This method of cutting the blocks, as well as the method of laying them, caused the edges to wear and to tear off rapidly. This then developed into a corduroy condition which greatly increased the tractive resistance to vehicles using the roadway, and also hastened decay, as water had no trouble whatever in penetrating through these interstices and lying under the block. It also made riding over the surface very rough and uncomfortable, and was alike hard on the vehicles, the horses, and the drivers or passengers in the vehicles.

To overcome these obstacles, which were not conducive to the laying of more wood block of this type, many other forms and designs of wood block were devised. After much experimenting, the standard rectangular wood block, closely resembling those in use to-day in shape and size, was adopted, and has undoubtedly proven the most satisfactory.

The block as it is now manufactured, is accurately cut from carefully selected, well-seasoned, long-leaf yellow pine, after which it is treated with a heavy coal-tar creosote. The blocks are laid with the grain vertical, a cushion of sand or cement mortar being laid on the concrete or other foundation, the former being preferred. The block are laid as close together as possible, and with the accurately cut block of to-day the interstices between the block are so closely formed that there is little, and often no, chance for any "brooming" of the edges. Traffic, it has been conclusively demonstrated, has no other effect on the block as now manufactured, than to make the surface tougher, and to practically obliterate the joints. After thorough tests, creosoted wood paving blocks are recognized as one of the very best, and in many cases the best, paving material for heavy traffic city streets, and are strongly endorsed by a large number of paving engineers. The largest cities of the United States, and a great many of the smaller ones also, have been using creosoted wood blocks very extensively, but during the past five or six years the increase has been the greatest. In this period, there has also been a very marked increase in the number of the smaller cities and even towns which have been using creosoted wood paving blocks on one or two or more of the main traveled streets, which are generally the business streets.

Its use has increased very rapidly in large cities, where the principal streets, which have to carry exceptionally heavy traffic, have been paved with wood block, replacing almost every other type of paving, records showing that it has even outlasted granite. Specific instances of streets which have been paved with various other materials which have later, under the heavy traffic, demanded repaving, and where wood block was decided upon, are practically all of the down-town streets in New York City, Market, Arch, Chestnut, and Twelfth streets in Philadelphia, and several of the most important streets in Pittsburgh.

Dayton, Ohio, two years ago, decided to pave two residential streets with creosoted wood block, and Grand Avenue and Forest Avenue were so improved. The wood blocks were three inches deep and were treated with twenty pounds of creosote to the cubic foot. They were furnished by the Compressed Wood Preserving Company, Winton Bank Building, Cincinnati, Ohio. While the paving of such streets was somewhat more expensive than would have been required by the actual traffic which passes over the streets, it was desired to reduce noise to a minimum. It has also been found that they are much easier to keep clean, and that the dust is reduced to a minimum. They have been eminently satisfactory, both to the city authorities and to the residents of the streets. Other streets in the residential section of Dayton have been paved with wood block since these streets were laid. These streets are all laid with a six-inch concrete foundation, on which is placed a one-inch sand cushion. The wood block are then placed and rolled with a light roller until the surface is smooth and the blocks conformed to the proper contour and grade. The interstices were filled with sand.

# The Street Cleaning Problem

I have been requested to come here and talk to you in detail and explain the object of the Association of Street Cleaning and Refuse Disposal Officials of the United States and Canada. This organization has been in contemplation for some time. Thanks to the efforts of Commissioner Fetherston and Secretary Buchanan, of the New York City Street Cleaning Department for their unceasing work and patience, it has now attained a growth which assures that branch of civic government an exchange of knowledge unsurpassed by any theoretical students of municipal problems. This is our main object; we hold that an interchange of ideas from practical men that have made our particular branch a study not from theory and unfathomable figures, but from actual *experience work,* thus giving cities or hamlets the benefit of a vast field of knowledge that could not otherwise be obtained.



GUS. A. HANNA

Street cleaning is not a romantic subject. It does not arouse the enthusiasm of citizens like a new public building or similar work of construction. It is not so exciting as putting out a fire or suppressing a riot. It is less of a kid glove job than caring for parks and playgrounds. Like woman's work, it is 'never done' but has to be repeated day after day and week after week.

The best street cleaning superintendent is the man you never hear about, because, if his work is done well, nobody ever thinks of him. If his work is neglected or badly done, he gets his name in letters an inch high on the front page of every paper. Yet, the street cleaning department is often the first agency of the city to feel the pruning knife, when it is necessary to cut down expenditures. That is how much glory there is in the street cleaning business. A street cleaner may save lives, by combating unsanitary conditions, but he gets no hero medals and no monuments.

I am not complaining of my job. I am simply explaining in advance why certain facts of which I will treat have escaped general attention. For example, it is common to divide paving costs under two heads, the cost of construction and the cost of repair. I maintain that the cost of cleaning is fully as significant a factor as the cost of repairs and is entitled to equal consideration in deciding any question of paving policy.

The street cleaners task is more directly reducible to a question of dollars and cents than is the paving engineers. When a street is clean, it is clean and there are no degrees of super-excellence to aim for. It must be the superintendent's continual study to effect this cleaning as cheaply as possible, both because the public grudges money for street cleaning and because, if there is sufficient money, what is saved in economical cleaning can be applied to more frequent cleaning. Therefore, economy must be the theme of any practical discussion of street cleaning. I will try briefly to tell you the result of my experience in three elements of economy:

First. The cheapest method of cleaning pavements.

Second. Methods of reducing litter.

Third. Paving policy with a view to saving the cost of cleaning.

The use of flushers has proven not only the cheapest but the most satisfactory method of street cleaning that our experience in Cleveland has been able to develop. We still make a considerable use of hand sweeping, but to make my point clear I need only refer to the statistics of our department which show an average cost of 15.3 per square of 10,000 square feet for flushing, to which must be added practically nine cents for pick-up work, a total of some twenty-four cents per square as against forty-two cents for the work of the white wings.

The white wing is too convenient and necessary an adjunct to be wholly displaced under any conditions. Down town streets must be swept continuously during the day and the hand sweeper, with his small cart, can also work to advantage in the gutters of residence streets, collecting dirt that has either been flushed or blown to the curbs. But so far as our experience goes, the lessening of cleaning cost by cheaper methods means simply the extension of the use of flushers at every practicable point.

There is an argument of sanitation in favor of the flushing method of cleaning. Dust breeds infection and is extremely unpleasant where it is not dangerous. Hand sweeping causes a certain amount of dust and mechanical sweeping, usually causes still more. However, with all that can be said on this score, I am opposed to simple sprinkling as a means of laying dust. Ammonia and other products leach out of damp manure and form a scum on the surface of the street that is nearly impossible to remove and makes the pavement slippery and foul smelling. Water should always be applied with force enough to carry the refuse to the gutter where it should be properly collected with brooms and shovels and removed.

The prevention of litter in streets has been carried farther, perhaps, in more congested cities than has yet been necessary in Cleveland. Even in our most crowded quarters, the street and sidewalks are rarely used as locations for garbage and ash cans, so one fruitful source of trouble in certain eastern cities is minimized in our case. We are reasonably successful in teaching the public to use waste paper boxes, but there is always room for improvement in such works of public education. We have tried during the past year to organize volunteer corps among school boys and girls who will use their influence against the useless littering of streets. The success of the venture is still at issue.

On the long run, nothing encourages carefulness on the part of the public so much as efficient and careful cleaning. A man does not hesitate to throw paper or rubbish into a street that is already foul. He thinks twice, if the street is neat and clean. If there is a waste box at hand with a printed word of suggestion on the outside, he is apt to use the box.

The greatest source of expense in Cleveland has come not from those who use the street for traffic, but those who use it as a place of business. A few hundred square feet near a certain street corner cost our department $10,000 to keep clean during the year last past. It is the location of a curb market, supposedly a farmers' market, but really the resort of professional hucksters who dispose of provisions that have often become shopworn in adjacent market houses before finding their way to the curb. It would be a small return for the privilege of doing business in the street to require these hucksters to keep their surroundings clean at their own expense, on pain of arrest or forfeitures of their privileges. My annual report recommends that some method be found of ridding the city of this form of imposition and I think that if the principle is applied in most cities to their market districts it will result in a considerable saving of cost.

In certain localities the mud that is tracked upon pavements is the greatest source of cleaning cost. Paving policies should be carried out with view to having a minimum number of unpaved approaches to existing pavements. I want also to point out the need of protecting narrow rural pavements from the overflow or tracking of mud that originates on adjacent portions of the same highway. Where half of a road is paved, care should be exercised to prevent the unpaved portion from draining across the paved portion. If the pavement is so narrow that teams must turn partly off from it at meeting points, the berms should be covered with broken stones or cinders to prevent tracking mud on the pavement. Few streets are so dangerous to auto traffic as a narrow suburban pavement with a film of fluid mud over it. The pitch frequently encountered on such pavements is enough when covered with slime to keep an auto continually skidding toward the curb. The cost of

An Address by Gus H. Hanna, First Vice-President of the Society for Street Cleaning and Refuse Disposal of the United States and Canada, and Commissioner of Street Cleaning, Cleveland, Ohio, delivered at Worcester, Massachusetts, December 16, 1915.

cleaning, under these circumstances, is higher than on other streets with ten times the traffic. With proper drainage, a shower ought to be a means of cleaning, not a means of contamination for an outlying pavement, even though it covers only a portion of the roadway.

But the foregoing measures are not so important or effectual in saving the cost of street administration as is the construction and maintenance of pavements that are easy to clean. It is a continual wonder to me that so little weight is given to cleaning cost when paving questions are settled. An annual expense of $500 a mile in repairing residence streets would be considered an appreciable item of maintenance, yet that figure for cleaning a mile of residence street through a season is extremely low. A cost of $500 for maintaining a mile of one kind of pavement for a year as against a cost of $1,500 for maintaining another kind would be sufficient grounds, in most cases, to decide in favor of the former material. Yet greater differences than this in cleaning cost as between competing types, are blandly overlooked.

A street cleaner looks for two qualities in a pavement. It must be smooth and particles of litter must not stick to the surface. The question of smoothness opens up the whole matter of durability. Any material that deteriorates and roughens becomes more difficult each year to clean. Any neglect of needed repairs means a larger cleaning bill until the repairs have been completed. I do not think it is necessary for me to discuss the durability of materials. Many of you are authorities on that subject. I merely wish to emphasize one thought that should enter into all your calculations of expense and that is the two-fold expense resulting from wear, the cost of repairs plus the increased cost of cleaning.

Additional calculation of cleaning expense must be made for all bituminous pavements on account of the sticking of particles of litter to the surface. These surfaces are never quite so clean as non-adhesive materials and it costs from twenty-five per cent. upward in additional cost to put them in a reasonably presentable condition, on account of this quality.

This difficulty is seen at its worst in a new creosoted wood block pavement, when the oil is gradually working out between the pores of the wood. The use of steel scrapers must often be employed, as the flushing by water is not effective at all in removing the dirt from such a surface.

The substances most easily cleaned, that enter into pavements, are brick and stone. Neither of them originates any form of dirt and both wash off readily. The only ground for discrimination between them is on the question of smoothness, where brick has a slight advantage as a rule. But in the use of these materials, the choice of a filler is all important. A bituminous filler has all the disadvantages of a bituminous surface, from a cleaner's standpoint, and some others besides. Being softer than the brick or block, it recedes, leaving a crevice that invites the lodgment of dirt. With the edges of the brick or block unprotected, it is sure to roughen, thus adding to the difficulties of cleaning. In fact, such a street, after a few years, presents an array of cobble stones, with the filler invisible, or else melted and run to the gutter, where it impedes the work of the follow-up gang.

So what I say in praise of brick and block pavements is meant to apply only to those built with a cement grout filler. I regret that I must rely upon general observations rather than exact data in supporting some of my statements, but it happens that we have in our office the result of observations made upon West Fourteenth Street, in Cleveland with view to determining the cost of cleaning. This is a grouted brick thoroughfare that has been paved some ten years and yet is in good enough condition to serve as a model of minimum cleaning cost. This street has a traffic of about two vehicles a minute. It has been cleaned, on an average, five times a week, being flushed by night and hand swept in the day time. The sweeper worked almost exclusively in the gutters, as most of the dust on such a pavement will be blown to the curbing in dry weather. The cost, per cleaning, amounts almost exactly to fifteen cents per 10,000 square feet, which we call a "square" and use as our unit of calculation.

This is the lowest figure that we have been able to achieve on any type of pavement. The cost on the best asphalt pavement would be not less than twenty cents and would raise to thirty as the surface became wavy or rough. A wood block pavement costs practically a dollar a square to clean in its initial condition and it will be at least two years before the oil will have dried out sufficiently to admit of its being cleaned for thirty cents a square. A tar filled block pavement will cost not less than thirty cents per square, and, as the filler disappears and the blocks roughen, this cost will amount to sixty cents or more.

So you can see how much weight I would put upon the question of cleaning cost in the selection of a material, as well as its construction. In the case of a pavement forty feet wide, there are about twenty-one squares to the mile. As between a material that can be cleaned for fifteen cents and one that can be cleaned for thirty cents, there is a difference of $3.15 per mile per cleaning, a difference of $15.75 per week, of $630 per season of forty weeks and $6,300 in ten years. And instead of thirty the cost of cleaning the latter pavement mounts to sixty cents per square, as is not uncommon under conditions of wear, the excess of cleaning cost will be $1,800 for a year or $18,000 for a decade above the figures that we have shown to be attainable on West Fourteenth Street. The successes of our department and the good sanitary record of our city is attributable in no small measure to the fact that we have miles of this type of brick pavement.

Cleaning costs can be greatly reduced by policy of prompt repairs. I believe in the continual patrol of all city streets by men whose duty it is to discover defects in pavements and prescribe repairs. Even from the standpoint of repair cost, such a system saves money. When cleaning is considered, as well as repairs, the saving of a patrol system is so great as to make any other system a luxury.

The bad pavement is the despair of the street cleaner. Every town has streets that ought to be called graveyards. There lie the remains of past paving failures; rutted, rough, and unsightly to reproach the men who laid them. As a street cleaning superintendent my last word of advice to you is to tear such pavements up and build pavements in which you can take pride. Build for ease of traction, build for durability, but also build for sanitation. Build a pavement that can be washed and swept clean. Such a policy is not expensive. The real extravagance is to keep pavements on your streets that are a barrier to traffic, a breeding place for germs and a burden upon the street cleaning department to keep in a condition of halfway presentability.

In view of our experience and the economy of cleaning streets of one kind compared with that of another, as well the difference in economy that is apparent to the man on the job, of a street out of repair and one in a maximum state for use, I wish to seriously submit for your consideration as to whether or not those who design, construct, and select pavements, have not lamentably failed in measuring the economy of a pavement by excluding every consideration which is involved in keeping them in clean, sanitary condition—confining their consideration simply to cost of construction, maintenance, and repair.

I am well aware that I have not covered in detail many questions which are involved in the economy and efficiency of street cleaning. If, however, I have failed to touch upon a question that any member in the audience may deem of sufficient importance to make inquiry, I shall be glad to answer to the best of my ability.

* * *

Wood block are being used in Harrisburg, Pennsylvania, as liners along the street car tracks on the asphaltic streets. Vitrified brick were formerly used, but they wore down very rapidly, and the result was that the asphalt adjoining the brick soon became very badly "chewed up" and bad depressions resulted. The maintenance charges were high, and the streets were in generally bad condition. The wood block used are the same size as the brick formerly used, and two courses are used on the inside of the rail and three courses on the outside. This improvement is being made just as rapidly as it becomes necessary to patch the asphalt, as tests have shown that the block lasts better and furnishes a smoother joint in turning off the tracks.

* * *

A week's course in road building and maintenance will be given under the direction of the Division of Engineering, Maryland Agriculture College, College Park, Maryland, January 10-15, 1916. Special attention will be given earth roads and county road problems.

# Annual Meeting of the Association of American Portland Cement Manufacturers

THE annual meeting of the Association of American Portland Cement Manufacturers was held at the Hotel Biltmore, New York City, December 13 to 16, both inclusive, and was one of the most important in the history of the Association in a number of respects. One of these, and in reality the most important, was a practical reconstruction of the policies of the Association, and an almost complete change in the officials.

Percy H. Wilson, who has been for some years the well-known secretary of the Association, resigned, his resignation taking effect immediately, and J. P. Beck, without question one of the best known and most popular men identified with the cement and concrete interests, was elected general manager, and will be in full charge of the Association's offices in Philadelphia. He will also have full charge of the vigorous publicity and advertising campaign which it was voted will be conducted during the present year.

Monday, December 13, the first day of the meeting, was devoted entirely to a series of important committee meetings. These meetings were all held at the Biltmore. The meeting of the Committee on Extension occupied the entire morning, while the afternoon was given over to the meetings of the Committees on Technical Research, Packages and Trade Conditions. All of these meetings were important and of great interest to the member companies and beneficial to the conduct of their particular business of manufacturing and marketing cement, but of little interest to the general public.



B. F. AFFLECK, President



J. P. BECK, General Manager

Tuesday was devoted to meetings of the Committees on Statistics, on Accident Prevention and on the Uniform Cost Sheet. An important meeting of the Executive Committee was also held in the evening. There was a dinner for the Executive Committee in the evening.

Wednesday we devoted to the annual business session of the Association, when the reports of the officers and of the various committees were presented to a full attendance. It is worthy of mention here that the Association of American Portland Cement Manufacturers now includes as active members about ninety-five per cent. of the total production of Portland cement produced in the United States, this increase having been gained by the admission of practically all of the important companies in the far west and on the Pacific Coast. It is now, without question, the strongest material organization of its kind in the entire country, and has accomplished in the comparatively few years of its existence, wonders in the promotion of the use of cement, and the proper use of this important material of construction, the latter purpose of the Association being considered equally important with the former. The constant aim of this Association is to have cement used in only the best, which is the proper manner, in the making of concrete, for whatever use it is intended.

The election of officers was also held on Wednesday, the result of the balloting by the member companies being as follows:

President, B. F. Affleck, President of the Universal Portland Cement Company; First vice-president, F. W. Kelley, President of the Helderberg Portland Cement Company; Second vice-president, Richard Hardy, President of the Dixie Portland Cement Company; Assistant secretary, Lewis R. Ferguson, who was re-elected to this office; Treasurer, G. S. Brown, President of the Alpha Portland Cement Company; Assistant treasurer, John J. Matthes, Treasurer of the Alpha Portland Cement Company.

The election of the above gentlemen undoubtedly gives the Association of American Portland Cement Manufacturers the strongest and most powerful official personnel it has ever had, and with Mr. J. P. Beck, who was elected General Manager, and is in charge of the offices, promotion and publicity, there is no question but that it will be more active and more aggressive in promoting the use of cement than ever before. Mr. Beck will make his headquarters in the general offices of the Association, Bellevue Court Building, Philadelphia, Pennsylvania, and personally worked out the new plans of the Association, having been engaged to do this some months ago. The annual dinner, one of the features of the annual meeting of the Association, was given on Wednesday evening, and was a most enjoyable event. Numerous addresses pertinent to the Association were made, and handsome remembrances were presented to the retiring president, John B. Lober, by the Association.

Another business session was held on Thusrday morning, at which session the summary of the proceedings of the German Portland Cement Association, as prepared by Robert W. Lesley and E. L. Conwell, was presented, the presentation of these proceedings being an annual event of the Association. A luncheon to the member companies was served at the Hotel Biltmore at noon, and this was followed by the final session of the annual meeting. This session consisted of a Re-organization Meeting of the Executive Committee, at which the very comprehensive plan of Mr. Beck was presented. This plan was unanimously approved by the Association, as well as a material increase in the assessment for the purposes of promotion and publicity. The Executive Committee was instructed,

by a resolution previously passed by the Association, which was attended by the presidents of the majority of the member companies present, to carry into operation the proposals made in the report of Mr. Beck. The promotion and proper construction of concrete roads, city streets and alley pavements, which consumes an enormous amount of cement annually, will be given special attention and featured by the new policy of the Association. Other uses of Portland cement will not be overlooked, however, as every branch of the industry will be assisted in every way possible. The meeting was then adjourned until the regular spring meeting of the Association.

# At the Sessions of Section D, Engineering, American Association for the Advancement of Science

## Held at Brown Hall, Ohio State University, Columbus, Ohio, the following program was carried out

Wednesday, December 29, 1915.

10:00 a.m.

"An Important Quality of Wood for Paving Purposes," Major W. W. Crosby, Chief Engineer, Maryland Geological and Economical Survey, and Consulting Engineer, Baltimore, Maryland.

"Recent Advancement in the Construction of Brick Pavements," Mr. William C. Perkins, Chief Engineer, The Dunn Wire-Cut Lug Brick Company, Conneaut, Ohio.

"A Study of Cushions for Block Pavements," Mr. Maurice B. Greenough, Instructor in Highway Engineering, Case School of Applied Science, Cleveland, Ohio.

"Brick and Concrete Paving Construction," Mr. Charles Latshaw, Sanitary and Highway Engineer, Fostoria, Ohio.

"A Study of Sands," Mr. A. D. Williams, Chief Road Engineer, State Road Bureau, Morgantown, West Virginia.

"Causes of Defects in Some Grouted Granite Block Pavements," Mr. C. D. Pollock, Consulting Engineer, New York City.

"Relative Advantages of Flat and Crowned Subgrades for Cement-Concrete Pavements," Mr. Lewis R. Ferguson, Assistant Secretary, Association of American Portland Cement Manufacturers, Philadelphia, Pensylvania.

"Factors Influencing the Bleeding of Wood Block Pavements," Mr. Hermann Von Schrenk, Consulting Timber Engineer, St. Louis, Missouri.

"Adaptability of Various Types of Pavements for Different Kinds of Traffic as Indicated by Service Tests," Mr. H. J. Fixmer, Division Engineer, Board of Local Improvements of the city of Chicago, Illinois.

"Pavement Maintenance Costs," Mr. H. H. Schmidt, Chief Engineer of the Bureau of Highways, Borough of Brooklyn, New York City.

"Identification of Bituminous Materials," Mr. H. B. Pullar, President, The Pioneer Asphalt Company, Lawrenceville, Illinois.

"Tests for the Determination of the Cementing Value of Bitumens," Mr. Philip P. Sharples, Manager, General Tarvia Department, Barrett Manufacturing Company, New York City.

"The Preparation and Use of Asphalt Cut-Back with Naphthá, for Road Surface Treatment," Mr. Julius Adler, Engineer of Tests, Bureau of Surveys, Department of Public Works, Philadelphia, Pennsylvania.

"Scientific Developments in Specifications for Sizes of Broken Stone," Arthur H. Blanchard, Professor in Charge of the Graduate Course in Highway Engineering, Columbia University, and Consulting Highway Engineer, New York City.

1:30 p.m.

"The Use of the Automobile Truck in Geodetic Surveying," Mr. William Bowie, Chief, Division of Geodesy, U. S. Coast and Geodetic Survey, Washington, D. C.

"Relative Carrying Capacities of Different Metals for Electrical Currents Greater Than Fusing Currents," Frank C. Wagner, Consulting Engineer and Professor of Mechanical and Electrical Engineering at Rose Polytechnic Institute, Terre Haute, Indiana.

"The Operation of the Cleveland Municipal Electric Light Plant," Mr. F. W. Ballard, Commissioner and Chief Engineer, Department of Light and Heat, Cleveland, Ohio.

"Motion Study for Crippled Soldiers," Mr. Frank B. Gilbreth, Consulting Engineer, Providence, Rhode Island.

"A Cylinder Friction and Lubrication Testing Apparatus," Alan E. Flowers, Professor of Electrical Engineering, The Ohio State University, Columbus, Ohio.

"The Aeration or Activation of Sewage," Mr. George T. Hammond, Consulting Engineer, Brooklyn, New York.

"Sewage Disposal Plants for Centralized Schools in Ohio," Mr. Arthur Richards, Consulting Engineer, Columbus, Ohio.

"Data Sheets—Their Relation to Engineering Science," Mr. Fred J. Trumper, Cleveland, Ohio.

"Dam Foundations," Mr. Caleb Mills Saville, Chief Engineer, Board of Water Commissioners, Hartford, Connecticut.

"The Standardization of Papers," Mr. Keppele Hall, Consulting Engineer, Bangor, Maine.

"Effects of the Glacial Epoch upon Engineering Works Within, or Adjacent to Glaciated Areas," Mr. M. D. Burke, Cincinnati, Ohio.

"The Design and Grinding of Metal Cutting Tools," Mr. J. Wendell Cole, Consulting Engineer, Columbus, Ohio.

"New Electro Magnetic Phenomena Demonstrated by Floating Sand, Pebbles, and Other Non-Conductors in Acidulated Water," Mr. J. C. Lincoln, President, The Lincoln Electric Company, Cleveland, Ohio.

"The Engineering Laboratories of The Ohio State University," William T. Magruder, Professor of Mechanical Engineering, The Ohio State University, Columbus, Ohio.

8:00 p.m.

"The Industrial Fellowships of the Mellon Institute, Five Years Progress in a System of Industrial Service," Dr. Raymond F. Bacon, Director, Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pennsylvania.

THE way to help your friends get in touch with the Road Movement is to encourage them to subscribe for "Better Roads and Streets."

# Important Decision on Luten Patents Handed Down

What designing, consulting, and contracting highway and bridge engineers consider one of the most important decisions relative to patents has been handed down in Colorado by Judge Robert E. Lewis of the United States District Court of Colorado. This was the decision rendered at Denver on November 13, last, against the patents granted to Daniel B. Luten, of Indianapolis, Indiana, the well-known concrete bridge engineer who has caused city, county, and State engineers so much trouble in almost every section of the United States in defending suits instituted for infringement under his patents for bridge design and reinforcement.

The decision handed down by Judge Lewis is far reaching in its scope, and in the plainest terms declares that the alleged inventions of Daniel B. Luten represent merely the exercise of engineering skill, and are therefore unpatentable at the time of application by the said Daniel B. Luten at the time of his application. The decision also states that his applications, and the subsequent patents that were granted were completely and thoroughly anticipated by prior patents, so that Daniel B. Luten is not, on the authority of the decision, the real inventor and originator of the claims set forth in his applications for patents.

The decision is a welcome one to every bridge and highway engineer in this country, and has again brought out most forcibly the inefficiency of our patent office, where the inventors of other nations say that any person can get a patent on anything for the fees, this having been clearly proven when a couple of years ago, patents were granted on the construction of concrete roads, although they had been in general use for many years before.

While the case will probably be taken by Luten to a higher court, the precedent has been set, and with engineers all over the country against the patents, they will lend all assistance in gathering a voluminous mass of testimony which will be used to show any higher court that the decision of the lower United States Court should be upheld. And if the decision of the Colorado court is upheld, this will do a great deal toward clearing up the situation as regards reinforced concrete patents. It will also destroy by making void a number of very annoying patents which have been issued to Daniel B. Luten, who is, without doubt, a clever engineer. The decision is of such importance, especially as the Senate of the United States last spring passed a resolution providing for a complete investigation of the legality of the issuing of the Luten patents, that it is given herewith in its entirety:

DANIEL B. LUTEN, COMPLAINANT, VS. GEORGE WASHBURN, ET. AL., DEFENDANTS.

Weld County, Colorado, through its co-defendant, Washburn, constructed a reinforced-concrete bridge having one span of about thirty feet across what is known as Sheep Draw on one of the public highways within that county; and thereafter the complainant brought his bill, in which he alleges that the defendants in so doing had been guilty of infringement of each of seven patents theretofore issued to him. The patents on which the suit is based are set up in the bill by the complainant thus, namely:

1. Letters Patent Number 852,970, issued on May 7, 1907, for certain new and useful improvements in bridges or arches of concrete or other analogous material, application for which was filed by the complainant, as he alleges, on February 13, 1905.

2. Letters Patent Number 853,183, issued May 7, 1907, for new and useful improvements in concrete and similar arches, application for which was filed by the complainant, as he alleges, on June 24, 1905.

3. Letters Patent Number 853,202, issued May 7, 1907, for certain new and useful improvements in arch structures, application for which was filed by the complainant, as he alleges, on July 25, 1904.

4. Letters Patent Number 853,203, issued May 7, 1907, for certain new and useful improvements in arches, application for which was filed by complainant, as he alleges, on July 25, 1904.

5. Letters Patent Number 933,771, issued September 14, 1909, for certain new and useful improvements in concrete bridges, application for which was filed by complainant, as he alleges, on March 29, 1909.

6. Letters Patent Number 979,776, issued December 27, 1910, for certain new and useful improvements in reinforced structures, application for which was filed by the complainant, as he alleges, on July 23, 1904.

7. Letters Patent Number 989,272, issued April 11, 1911, for certain new and useful improvements in reinforced structures, application for which was filed by the complainant, as he alleges, on December 9, 1908.

The answer pleads the general issue as to each patent; it also denies invention as to each patent, denies that the complainant was the original and first inventor as to each; and sets up anticipation in other named patents and also description in named printed publication more than two years prior to complainant's several applications, and that each includes and covers matters of public and common knowledge and in public use for more than two years prior to the applications and more than two years prior to the supposed discovery by complainant. The answer also specifically denies infringement.

The relief sought is an injunction against further alleged threatened infringement and for profits and damages.

The bill also sets up adjudications in favor of complainant in fourteen separate suits or actions which he brought in other jurisdictions, and in which the validity of one or more of these patents was involved in each of the said suits or actions. But in all of those cases the decrees and judgments offered in evidence show that they were had either proconfesso or by agreement, and if not by agreement, it is admitted that no defense was, in fact, made. Experience has caused me to feel that such proceedings ought to be given but scarce, if any, weight. I will go so far as to say that experience has given me the impression that it has become a favored method to follow that practice for the principal purpose of thus building a basis on which to attempt to sustain a patent when it is later seriously contested, and I have of late declined to enter decrees if, after inquiry as to the true facts, I could appropriately avoid doing so.

At the trial the complainant did not introduce patent number 933,771, but relied on the other six patents.

a. The claims under patent number 852,970, on which reliance is placed to establish that the defendants' bridge was an infringement, relate only to the wings and abutments of the bridge, and consist in the binding together of each wing to each abutment, and the abutments and the two wings at either end of the bridge by reinforcing rods extending into and through them.

b. The claims under patent number 853,183, on which reliance is placed to establish that the defendants' bridge was an infringement, relate to the formation at the juncture of the outer rib or girder of the bridge at each of its ends with the abutments—that is, an arched kneebrace set in the under angle formed by the girder and the abutment as distinguished from the triangular kneebraces under the inner girders; and also in the structure having two outer ribs or girders projecting both above and below, and with a roadway between the upper ribs or girders, with reinforcing members in the lower ribs.

c. The claims under the patent number 853,202, on which the reliance is placed to establish that the defendants' bridge was an infringement, relate to a bridge spandrel or retaining wall of concrete with reinforcing members near the stream and roadway surfaces, to the extension of such spandrel or girder across the abutment and cantilevered in the abutment with tension members extending across the abutment near the upper surfaces of the spandrel or girder, to longitudinal reinforcing tension members near the lower surface of said spandrel or girder, said tension members having upward extensions toward the ends of the girders, and to reinforcing tension members embedded near the lower surfaces of said spandrels or girders and having a plurality of sheer members entending upwardly and inclined toward the ends of the girders, and tension members embedded near the upper surfaces of the girders and over the abutment.

(Continued on page 47.)

# Better Roads and Streets

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To you
And yours
And your business.
May you have good health,
Bountifully prosper and
Make money, and
Realize that it pays
To advertise in
"Better Roads and Streets."

* * *

Regardless of type, roads and streets must be kept smooth to give satisfaction.

* * *

We are for new construction just as fast as the money is forthcoming for that purpose, but great stress should be laid upon the subject of repair and maintenance.

* * *

Public meetings are necessary everywhere to discuss ways and means for the construction, repair, and maintenance of public roads and streets.

* * *

We try to be consistent and, therefore, we contend for one annual national road congress, and oppose all others national in scope.

* * *

The condition of the public highways in the United States is a great surprise to the foreign traveler who has been used to smooth, hard roads through his land—kept so by constant maintenance.

* * *

It is one thing to get an accounting for the expenditure of road and street funds and another to get the maximum results which should be the aim of every individual and official interested in the improvement of roads and streets.

* * *

Every county should have some official in charge of the expenditure of road funds and a public record should be kept which should show the value of every movement and every cent expended.

Plans are under way to submit a $100,000 bond issue to the voters of Mason County, Michigan, at the spring election, for the purpose of completing the county gravel road system. There are 127¼ miles in the county system, ninety-six of which are improved.

* * *

The business of W. W. Williams, Contractors Machinery and Supplies, 507-11 Brunson Building, Columbus, Ohio, will be continued under the same name, and there will be no change in either name, plans, or policy. Mr. W. S. Williams, a brother of W. W. Williams, has been inaugurated as first assistant.

* * *

The front cover page of this issue was made from a photograph of South High Street, Columbus, Ohio, at the corner of High and Town streets. The Cleveland Trinidad Paving Company, Cleveland, Ohio, was the contractor and Trindad Lake Asphalt was used.

* * *

Not only must all articles of manufacture and products of the farm and garden pass over a public road or a street on the way to their destination, but every meeting of either political, social, or religious nature must be made up of persons who pass over a public road or a public street.

* * *

Initiation into the Ancient Order of Good Roaders formed part of the entertainment extended by the Commercial Club, of Topeka, Kansas, to the county road officials who met at Topeka for their annual convention November 30 to December 2, 1915.

* * *

Without a dissenting vote, the board of supervisors of Oakland County have decided to submit a $1,000,000 bond issue for roads to the voters at the April election. According to the computation of the equalization committee the county's valuation is $68,000,000, an increase over 1914 of $1,250,000.

* * *

The Third Annual International Road Congress was held at London, England, during the summer of 1914. Didn't the Chamber of Commerce at Worchester, Massachusetts, know this when the country was being flooded with advertisements for the holding of the "First International Road Congress" at that city in December, 1915?

* * *

In both county and city a tabulated list of amounts expended on roads or streets should be kept so that any citizen or official might readily determine just what has been or is being expended on any road or street. The records should show the condition of every fund and the amount appropriated to each piece of work.

* * *

The selection of the proper type of a road and the determining of where to place it is not a gift given to the average layman, and can only be acquired after years of careful study, not only along engineering lines, but the careful observation and study of the results found in the use of the various types and a close observation of the traffic over the roads.

* * *

In past years, automobile owners of the State of Pennsylvania have been permitted to drive their cars on the roads for a month and even more, after the first day of January with the old license plate still on the car, This year, this practice will not be permitted, and 1916 license plates must be used, starting January first.

* * *

In the article on Lake County, Indiana, highways in our December number, we omitted mention of the United States Crushed Stone Company, Chicago, Illinois, as the company furnishing a large proportion of the stone used in the construction and maintenance of Lake County's 550 miles of waterbound and bituminous macadam roads.

* * *

Contractor A. L. Cook, of Ottawa, Kansas, took no chances with the weather last fall while finishing up a large brick paving contract in that city. Beginning November 19 two shifts were used on the job, making the pavement construction continuous from 7:00 a.m. till 11:00 p.m. until the work was completed. Asphalt filler was used for the joints.

A road bond issue of $100,000 will be on the Clinton County, Michigan, ballot at the April election, according to the decision of the board of supervisors. If the issue wins, $85,000 will be used for two trunk lines and the remaining $15,000 for that portion of the Wolverine Highway passing through Eagle township.

* * *

Commissioner Williams, of West Virginia, says: "The young man wants good roads to save his clothes, his team, his resources and his time and temper." He also says: "The young woman desires to go to church, to attend social gatherings and to mingle with other young people. For this reason, as well as many others, the young woman also appreciates and wants good roads."

* * *

The Lehigh Portland Cement Company, Allentown, Pennsylvania, announces that Harold M. Scott has been appointed assistant secretary and B. H. Rader western sales manager of the company. Both of these gentlemen will have their headquarters at the Chicago offices of the Lehigh Portland Cement Company. Mr. Rader was formerly in charge of the Pittsburgh office of the Universal Portland Cement Company.

* * *

Subsequent to the publication of the article "What Berrien County, Michigan, is Doing" in the November issue, it has come to our attention that the oil spraying attachments on Berrien County's motor driven oiler were furnished by the Austin-Western Road Machinery Company, Chicago. J. E. Allen of the Allen Construction Company, Chicago, and formerly with the Austin-Western Company, designed the machine.

* * *

B. H. Rader, formerly Vice President and Sales Manager of the Hagar Portland Cement Company, Chicago, has resigned to accept the position of Western Sales Manager of the Lehigh Portland Cement Company with headquarters at Chicago. Before the formation of the Hagar Cement Company, Mr. Rader was Eastern Sales Agent of the Universal Portland Cement Company at Pittsburgh.

* * *

State Treasurer, Earl Akers, of Kansas, who is quite a good roads booster, has figured out that if a tax of five cents an acre was levied on the land of Kansas each year for twenty years, the amount realized would build two concrete roads across the State from Missouri to Colorado and four from Nebraska to Oklahoma.

* * *

The University of Pittsburgh will hold a special course in highway engineering at the School of Engineering, Pittsburgh, Pennsylvania, January 31 to February 5, inclusive. An elaborate program has been prepared, and addressed and talks will be given by some of the best known highway engineers in the country. The Pennsylvania State Highway Department is co-operating with the University of Pittsburgh, and will have a special day set aside for the Department.

* * *

By special, though informal, request of the Association of State Highway Officials through one of its officers, we call attention to the splendid treatment accorded the association by the LaSalle Hotel, Chicago. Though a small meeting in point of attendance compared with the many other conventions held in the great convention city, every courtesy was accorded the members in the way of rooms and other services tending toward their comfort and convenience.

* * *

On Sunday, October 24, 1915, a count was kept of the number of automobiles passing over the Moweaqua-Decatur oiled earth road whose construction was described in the November issue of Better Roads and Streets. The results were as follows:

Between 2:00 p.m. and 3:00 p.m., 142 machines; 3:00 to 4:00 p.m., 125 machines; 4:00 to 5:00 p.m., 225 machines; total for three hours, 492 machines.

* * *

What is thought to be the Indiana record for the amount of concrete paving laid by one contractor in a single season, was established during 1915 by the Masters Construction Company, of Seymour, Indiana, with 90,000 square yards in Anderson, Indiana. Seven streets were paved, the total contract price being $157,000. Between seventy and one hundred and ten men were on the company's pay-roll during the entire season. The biggest ten hours' work was 980 square yards.

* * *

The board of supervisors of Shiawassee County, Michigan, are preparing to submit a $200,000 bond issue for State reward roads at the April election. Maps of the proposed roads have been prepared and a resolution has been made by the board of county road commissioners asking that the issue be placed on the ballot.

It is figured that with the $200,000 the county can raise its good road mileage to over two hundred miles.

* * *

The road bond issue question has come up in Stephenson County, Illinois, and is receiving enthusiastic support. Secretary Simpson, of the Freeport Chamber of Commerce announces that data is being prepared which will show the cost of the proposed improvements. Figured on a basis of a bond issue of $850,000, the limit for which the county could be bonded, it would cost less than sixty-one cents to each individual paying taxes, this being as low as the township tax. The township tax is now sixty-one cents, the highest possible amount to assess.

* * *



* * *

Plans for a $2,000,000 bond issue for concrete or other hard surfaced roads, to be submitted to the voters at the November, 1916, election forms the principal activity of the Will County (Ill.) Automobile and Good Roads Association. The sentiment in the county seems to be strongly in favor of the issue, but this only serves to increase the ardor of the officers of the association, who have inaugurated a campaign of education throughout the county. Officers of the association are, President, J. R. Blackhall, Joliet, Illinois; Secretary, E. B. Scagnelli, Joliet, Illinois.

* * *

Incorporation papers have been issued to the LaSalle County Good Roads Association, with C. E. Hook, M. J. Sheehan, and Robert Thompson as incorporators. The immediate object of the association is to push the $1,500,000 bond issue for hard roads in LaSalle County, which is to come up for vote at the next election.

The LaSalle County Bankers' Association, at a recent session went on record as endorsing the proposed bond issue to enable the county to build State-aid roads.

* * *

The county surveyors of Ohio, now also county highway superintendents, are busy complying with the provisions of the Cass Road Law in numbering the roads of their respective counties. Immediately following this we hope the county commissioners will require the county highway superintendent to report to the county auditor all sums expended upon every road; require the county auditor to open a permanent account record with each road and charge every item of expenditure to the respective roads, so that the people sometime, by this method, may know where their money is being expended.

* * *

WE DIFFER SLIGHTLY.

Out in Rooks County, Kansas, petitions have been gotten up to recall two road commissioners who have failed to keep the roads in repair. The Leavenworth Gazette remarks editorially, "If this way of handling the road problem should be-

come popular, we can get good roads without all this fuss we have been making. Any old commissioner who thinks he is in danger of losing his job will keep the roads up." We agree; but vote him some money first and give him a chance.

* * *

ASSOCIATION OF SOUTH DAKOTA COMMISSIONERS.

Forty-six representatives from seventeen counties were present at a meeting held at Mitchell, South Dakota for the purpose of forming a county commissioners' association. The counties represented were Bonhomme, Charles Mix, Clay, Davison, Douglas, Grant, Jerauld, Lincoln, Lyman, McCook, Minnehaha, Faulk, Sanborn, Gregory, Miner, and Kingsbury.

The following officers were elected: President, W. F. Brazzill, Charles Mix County; Vice President, F. L. Clark, Lawrence; Secretary-Treasurer, C. T. Charnock, Minnehaha.

* * *

Long Island, New York, is to have a boulevard highway along the Great South Beach at Westhampton. The commissioners anticipated some opposition to the construction of this highway, which will be one of the most important in Long Island for pleasure traffic, and were agreebly surprised at the meeting held in November at Patchogue to learn that the residents and property owners were unanimous in demanding that the improvement be made. The damages were then assessed, and the construction of the highway will be started as soon as the weather will permit in the spring. It will be ten miles in length.

* * *



* * *

The Fuller Engineering Company, Allentown, Pennsylvania, has been awarded the contract for designing and constructing a large, new cement plant to be built this winter at Foreman, Arkansas, for the Consumer's Portland Cement Company. This concern has its general offices in the Lumber Exchange Building, Chicago. The proposed new plant will be one of the largest, and the most modern in the entire Southwest, with a capacity of two thousand barrels of cement per day, all of which will be manufactured by the dry process. Albert Graff is president of the cement company, Edgar S. Bell is vice president and treasurer, and D. G. Johnston is secretary. All of these gentlemen have their headquarters at the Chicago address as given above.

* * *

All who have ever toured through eastern Pennsylvania are familiar with the toll-gate outrage that that section of the State is pestered with. Complaints this fall and winter have been more frequent than ever before, as nearly all of the roads are in either bad or dangerous condition, the owners neglecting to do any repairing owing to their desire to have the State purchase them. But the State Highway Department has given them all a shock, having refused to take over any roads that are not in first-class condition. This purpose became known when the owners of a well-known toll road tried to palm off a road in miserable condition at an enormous price, but received a merited turn-down from the Department, but it was late in the year and cold weather arrived before the repairs could be made.

* * *

On Saturday, October 30, 1915, Webster County's first traffic census was taken under the direction of County Engineer, G. P. Smith, of Fort Dodge. Mr. Smith had men stationed at each of the county roads entering the city, who counted the number and character of vehicles and the number of passengers carried.

The results of the count show that a total of 1,670 cars used the roads carrying 5,288 passengers, against 487 horse-drawn vehicles carrying 874 passengers; in other words, seventy-eight per cent. motor traffic and twenty-two per cent., horse drawn.

Mr. Smith estimates that if the count had included the township roads, the total passengers would have been close to 6,000.

* * *

ORIGIN OF ROAD RULES.

The origin of the rule for pedestrians to keep to the right dates back to a period when such things as roads were unknown. Before the road as we know it existed, progress from place to place was accomplished by means of tracks or paths, used in common by mounted and foot wayfarers. As in early days every traveler carried his life in his hands and saw in every approaching stranger a potential enemy, so the unarmed man either retreated from the path or was beaten from it by an advancing stranger, if the latter were armed. When two armed men met with shield on left arm and sword in right hand, they of necessity passed each other on the right, so as to bring shield to shield, thus completely sheltered, but with the sword arm ready to strike if needed.—*London Globe.*

* * *

The Garford Motor Truck Company, Lima, Ohio, has inaugurated a novel service at its branch in Philadelphia that is making a hit and many friends for this well-known company. A series of meetings for the owners and drivers of Garford trucks is being held at the Philadelphia branch and at these meetings, the truck itself is explained in detail and its working and upkeep studied. But of equal value is the detailed information that is presented to those present as to how the greatest efficiency can be secured on all kinds of hauling, and in all lines of business. Considerable attention has been given at the three meetings that have already been held, to the proper operation and earning capacity of the automatic dump body trucks in all sizes which this concern builds for street and road contractors.

* * *

Among the well-known material men who attended the Third Pennsylvania Welfare, Efficiency and Engineering Conference at Harrisburg, Pennsylvania, the latter part of November, were the following: M. E. McDonough, Philadelphia manager of John Baker, Jr.; John C. Leonard, Manager of the Tarvia Department of the Barrett Manufacturing Company, Philadelphia; William C. Craven, of the Philadelphia office of the Standard Oil Company; Harold Stone, of the Atlantic Refining Company, Philadelphia; W. W. Cunningham, General Manager of the Pennsylvania Clay Company, Pittsburgh, George P. Hemstreet, mechanical engineer of the Hastings Pavement Company, Hastings-on-Hudson, New York, and H. B. Allen, manager of the Philadelphia office of the General Crushed Stone Company and the Amies Road Company.

* * *

The Philadelphia Electric Company, Philadelphia, Pennsylvania, has again been awarded the annual contract for lighting the streets of Philadelphia with electric light. The contract price for 1916 is $84 per lamp, which means that the total expenditure for lighting the city this year will be $1,285,000, or about $150,000 more than in 1915. This increase is due to the fact that many extra lamps have been added during the year. The city of Philadelphia has, for several years, been fighting the Philadelphia Electric Company to secure a lower rate for electric current, not only for the city streets and public buildings, but for the private consumer as well, and it is generally conceded that Director Morris L. Cooke, who has been leading the fight, will be successful, and that the Public Service Commission will order a reduction in rates. The provision is made in the 1916 contract that should the rate be ordered reduced at any time during 1916, the bid will automatically be made retro-active.

* * *

## County System in Wisconsin Produces Good Roads

Roads are much better in northern Wisconsin than in the southern sections of the State, was the opinion of Chief Engineer A. R. Hirst after returning from a two weeks' inspection tour in the upper region. In Ashland County, he said, is a

single stretch of sixty-five miles of road over every foot of which automobiles may safely be driven at high speed. Other long stretches, he said, are found in various northern counties, eight, ten, and even twenty miles of finished road without a break.

This condition, Mr. Hirst said, is due to the fact that many of the northern counties have adopted the county system in place of the town system. These counties are Douglas, Bayfield, Sawyer, Ashland, Iron, Oneida, Vilas, Florance, Wood, and Chippewa. Several others are to adopt the system next year.

In the southern section, the only counties to adopt the county plan are Milwaukee, Richland, and Fond du Lac. All the other southern counties retain the barbaric town system, which spells patchwork—a little stretch of good road here, a little there, with mudholes in between.

Speaking of the sixty-five-mile stretch of finished road in Ashland County, Mr. Hirst explained that it is maintained under the patrol system. The road is divided into sections. One man, who is conveniently located, is charged with the duty of looking after the maintenance of each section and is well paid for the service.

* * *

The Pennsylvania State Highway Department has awarded contracts for three different kinds of highway construction, the types of surface, successful contractors and the bids being as follows:

Brick block pavement in Marion Center Borough, Indiana County, length, 4,054 feet. The contract was awarded to Mark Bennett & Sons, Indiana, Pennsylvania, at $16,639.74.

Concrete pavement on Wynnewood Road, Marberth Borough, Montgomery County, length, 1,756 feet. Contract awarded to the Pugh & Hubbard Company, 731 Witherspoon Building, Philadelphia, Pennsylvania. Bids were taken on concrete, Warrenite, Amiesite and Filbertine, and for the three latter types were as follows: Warrenite, $7,951.10; Amiesite, $7,216.55, and Filbertine, $7,535.75.

Water-bound macadam road in Hickory township, Lawrence County, length, 5,808 feet. Contract awarded to Mark Bennett & Sons, Indiana, Pennsylvania.

* * *



* * *

## Much New Road Construction is Planned in Florida

Although it does not seem to be generally known, and due credit is not being given, Florida is, and has been all through the year just closed, doing a great deal of road work, and also proposes to continue this program. For many years, there was little or no interest taken in road improvement, and the little construction that was undertaken was practically all in the immediate vicinity of some of the larger cities. The State itself took little interest in the all-important problem of improving the roads, and, in fact, even at the present time, takes little official interest. Nearly all of the work that has been done has been done by the counties, and this has all been within the past three years. The population of the southern half of the State has been increasing very rapidly, every county showing an increase of more than fifty per cent. in the past ten years.

Prior to three years ago, the work that was done by the counties was in a more or less slip-shod manner, and only on a small scale. Then Hillsborough County, which is in about the center of the State on the Gulf Coast, undertook the construction of a modern road system on a large scale. A bond issue of $1,000,000 was authorized by a vote of the people, and there was little difficulty in disposing of the bonds. An engineer was retained to prepare plans and specifications covering the best road system that could be constructed for this sum and the work was soon placed under contract under the supervision of this engineer. The county now has an excellent system of highways, although it is making a serious mistake—and what will, in the future, be a very costly one—in not properly providing for their maintenance. During the past two years, several other counties followed the example of Hillsborough County, all arranging for bond issues. The advantages of the construction of a county road system that would connect up with the system of the adjoining counties, was soon realized by other counties, and in 1915, no less than twelve counties voted substantial bond issues for the construction of roads. These twelve counties authorized the expenditure of more than $4,875,000 for this work, and most of it will be under way this winter, as the climate permits of work throughout the entire year. In addition to the twelve counties referred to, seven other counties have announced that elections will be held on proposed bond issues, the aggregate of which will be over $3,250,000. Florida will, therefore, have very close to $8,200,000 available for road construction, as there is little doubt but that the remaining seven bond issues will pass by large majorities. There are also several additional counties which, although they have not agreed upon bond issues, are planning to hold elections this year.

It will be seen from the foregoing statements, that Florida, as a road-building State, easily leads all other Southern States, and ranks well up with the leading States of the North when it comes to the amount of money to be expended in road improvement. Practically all of the work is placed under contract, these contracts generally covering long sections of roads, making it worth while for a contractor to bid on the work, and after securing his contract, to execute it with the aid of modern road-building equipment. That the contracts are desirable is evidenced by the fact that one of the most important contracts now under way is held by a large concern in New York City, while others are in the hands of contractors in Georgia and other States. Machinery and material manufacturers have been selling much equipment and material to the State, and this is going to show a still greater volume. The manufacturers of equipment and materials used in maintenance and repair will also do considerable business in the State, as the county commissioners, who have charge of the roads after they are completed, are beginning to realize that they will have to properly take care of and maintain the roads after they are once completed, and that this can be best and most economically done by purchasing the necessary equipment.

The counties which have, during 1915, authorized bond issues for road improvement, and which either have the work under way at the present time or will start it this winter, are as follows, the figures representing the amount of the authorized bond issue:

Clay $150,000; De Soto, $760,000; Hernando, $150,000; Lake, $500,000; Lee, $177,000; Leon, $200,000; Orange, $600,000; Palm Beach, $800,000; Pasco, $258,500; Putnam, $233,000; Seminole, $450,000; St. Lucie, $600,000. Total authorized, $4,878,500.

The county seats, which are the headquarters of the county commissioners of the above counties, are located as follows, the name of the county in each case being followed by the county-seat town:

Clay, Green Cave Springs; DeSoto, Arcadia; Hernando, Brooksville; Lake, Tavares; Lee, Fort Myers; Leon, Tallahassee; Orange, Orlando; Palm Beach, West Palm Beach; Pasco, Dade City; Putman, Palatka; Seminole, Sanford; and St. Lucie, Fort Pierce.

Bond issues are pending, and from the sentiment in their favor, are all expected to pass, in the following counties:

Columbia, $350,000; Dade, $275,000; Lafayette, $300,000; Lee, $125,000; Pinellas, $715,000; Polk, $1,000,000; Taylor, $500,000. Total, $3,265,000.

The county seats of the above counties are as follows:

Columbia, Lake City; Dade, Miami; Lafayette, Mayo; Lee, Fort Myers; Pinellas, Clearwater; Polk, Bartow; and Taylor, Perry.

Practically every type of pavement construction is being built in Florida, the pavements under way and proposed including brick, concrete, sheet asphalt, modified asphalt, bituminous macadam and sheel, and waterbound macadam.

## Brown County, Wisconsin, Plans to Build 145-Mile System of Hard Roads in Ten Years

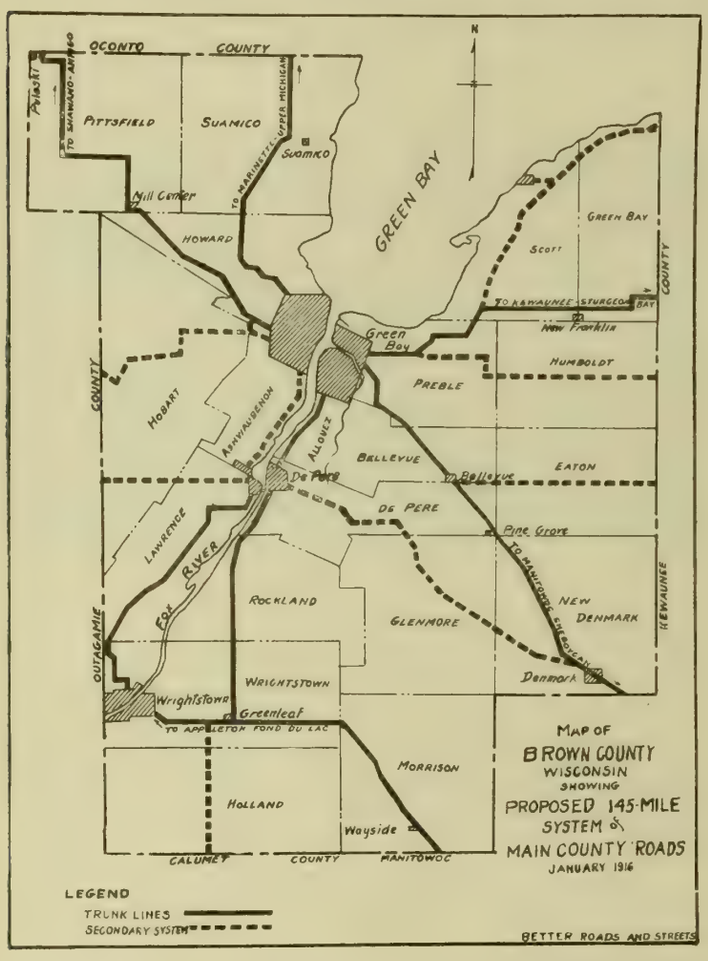
The accompanying map represents the system of county concrete roads which Brown County, Wisconsin, proposes to build under a combination scheme of bond issue and direct taxation.

The highways designated by the county board as the "County Trunk System" are shown in heavy black lines and are the roads which the advocates of the plan, propose to construct immediately under a bond issue of $650,000. This system comprises eighty-five miles.

The "Secondary System," sixty miles in length, is to be constructed at the rate of six miles a year. Under this plan it is figured that there will be no increase in taxes in the county, the complete scheme of finance being as follows:

The average expenditure for roads in Brown County for the past three years has averaged more than $100,000 per annum. Under the new scheme it is planned to make the annual appropriation an even $100,000.

Bonds are to be issued to the amount of $650,000, providing for the immediate construction of the eighty-five miles of trunk road, and payable in annual installments during a period




of twenty years. With interest at four and one-half per cent. this would require an average payment of $55,168.75 annually during the first ten-year period, while for the second ten-year period it would be less.

Deducting the $55,168.75 annual payment during the first ten-year period from the appropriation of $100,000, leaves a balance of $44,831.25, which would be used to construct approximately six miles of concrete road each year on the secondary system. In ten years this would produce sixty miles of road in addition to the eighty-five miles of trunk line roads to be built immediately.

It is also figured that the saving on maintenance would be approximately $20,000 per annum, and could be applied for aiding such towns as should desire to improve their lateral roads running up to the concrete system with macadam. This latter repair item has not heretofore been included in the annual highway levy; neither is it included in the foregoing computations, and during a ten-year period it would represent a saving of nearly $200,000 to the taxpayers of the county, or, if made available for new work, it would provide funds for building several miles of macadam road each year on the lesser traveled lateral town roads.

* * *

James Casler, commissioner of Eaton County, Michigan, has devised a new plan for financing roads built within the corporate limits of cities. According to the State law, State reward cannot be paid for such roads so Mr. Casler proposes that the cities pay the reward instead. This plan has met with the approval of the cities of Charlotte, Eaton Rapids, and Grand Ledge and the village of Potterville, and in consequence, a considerable mileage of county roads will be built inside of the corporate limits of these municipalities next year.

Eaton County has appropriated funds for road work next year as follows: for new construction, $53,662; for repairs, $5,000; for road building machinery, $1,500. This is the largest year's appropriation for roads in the history of Eaton County.

* * *

The Concrete Extension Bureau has been formed as a clearing house of information on the use of Portland cement in any and all forms, and for all uses. The headquarters of the Bureau are at Dallas, Texas, and the territory served will be the entire Southwest, where the use of concrete has been growing rapidly. Especial attention will be given to concrete paving and cement sidewalk construction. Bulletins will be issued as conditions warrant on various subjects, and every effort will be made to further increase the consumption of Portland cement, and at the same time to insure its proper use in every class of work. Complete files of information will be kept always up-to-date, and literature on concrete and its uses will be kept at the offices of the Bureau, which will be supported by the cement companies operating plants in that section of the country. L. S. Bruner is in charge of the offices, and is an engineer of wide experience. Mr. Bruner has been for some years the engineer in charge of publicity work for the Canada Cement Company, Ltd., Montreal, Canada, and the largest producer of cement in the Dominion. The purpose of the new Bureau is similar to that of the Association of American Portland Cement Manufacturers, which has its headquarters at Philadelphia, Pennsylvania.

* * *

## A Busy Street

I love a busy, hustling town!
One day they put the paving down,
All nice and smooth and sweet, and then
Next day they tear it up again.
From one end of the street back to
Its other end, that's what they do;
And then they get it smooth and flat,
And give it its last loving pat.
And then there is a shriek of fear
Comes from the city engineer—
He has mislaid his monkey-wrench!
And instantly they start a trench
And toss the pavement all around
Until the monkey-wrench is found!
And then they tramp the dirt in tight,
And get it leveled off all right,
And surface it with hard concrete,
And make a street as is a street
By putting sand and brick on that,
And the steam roller makes it flat.
Then they pierce that pavement through and through
To lay a line of pipe or two!
Then they repair that, and it lies
Smoothly beneath the summer skies
For, it may be, a day or two;
Then there's a sewer to run through!
Now, when some one you chance to meet
Talks of the "busy city street,"
That's what he means in this man's town,
The street that's getting up and down,
And rolling over that way, till
It just seems like it can't lie still.

— *Judd M. Lewis in the Houston Post.*



*View* 1—Looking down General Lee Street from intersection of Dolores Street, Marianao, Cuba. View taken April 1915. Plain macadam laid in October 1914. Note destruction of gutters by tropical rains



*View* 2—Looking up General Lee Street from intersection of Dolores Street, Marianao, Cuba. View taken April 1915. Tarvia macadam laid in August 1914.

# *Tarvia versus Tropical Rains*

HERE is a street in Marianao, Cuba, which was paved with plain macadam.

*View* 1 shows what it looked like six months later with the gutters all washed out by the tropical rains, so that the two sides of the road were mere heaps of broken stone.

*View* 2 shows an adjoining section of the same street which was paved with Tarvia macadam a short time previously. But after six months, as the view shows, the tarviated-macadam was just as good as new and the heavy rains had not injured it a particle.

The relative superiority of Tarvia shown in this test in Cuba holds good for this country except that the contrast will not be so promptly shown. Nevertheless the superiority of tarvia-bonded macadam is speedily apparent.

To be sure, tarvia-macadam costs a little bit more to build than plain, water-bonded macadam but it lasts so much longer and requires so much less maintenance that the extra first cost is more than repaid.

**Tarvia**
***Preserves Roads***
***Prevents Dust~***

In the long run macadam is very expensive because it was not designed for modern automobile traffic and quickly disintegrates when its tender surface is subjected to twentieth century traffic.

*Booklets discussing the road problem in detail on request. Address our nearest office.*

### *Special Service Department*

This Company has a corps of trained engineers and chemists who have given years of study to modern road problems.
The advice of these men may be had for the asking by any one interested.
If you will write to the nearest office regarding road problems and conditions in your vicinity the matter will have prompt attention.

BARRETT MANUFACTURING COMPANY

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Allentown Easton Road. Concrete Highway Joints Protected with Kahn Armor Plates

PERFECT CONCRETE ROADS

Proper Protection of Joints with

KAHN ARMOR PLATES

The bevelled edge prevents clipping off of concrete at joint. Correct placing of joint assured by

IMPROVED INSTALLING DEVICE

Also Kahn Mesh for reinforcing concrete roads, **Kahn Elastic Filler, Trus-Con Side Forms** and **Kahn Curb Bars.**

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*Representatives in Principal Cities*

KAHN Building Products
TRUSSED CONCRETE STEEL CO.

# Points To Be Emphasized

"In the resurfacing of water-bound macadam it is frequently the case that the engineer in charge of the work allows too small a stone to be used, which, it is true, will require decidedly less rolling but will not stand the motor traffic of to-day.

Another fault quite often found is the spreading of screenings before the one and one-half inch stone is thoroughly locked, and very frequently using too large quantities of screenings, thereby causing a heavy crust to form on the road surface.

The success of the bituminous treatment of water-bound macadam roads depends entirely upon the cleanliness of the road before the application of the material. Many failures are due to the lack of proper care in this most important detail. In cleaning the surface of the road, the sweeping should be windrowed along the edges of the wearing surface, in order to prevent the running off of the bituminous material, which later should be swept back on the road. Special attention should also be given to applying the chips, just sufficient chips being used to prevent the traffic from picking up the bituminous material.

In bituminous macadam or penetration work, no bituminous binder should be applied unless the stone surface is thoroughly dry, and the temperature of the air is sixty-five degrees or higher, and special attention paid to the heating and applying of the binder.

One of the important features in connection with obtaining the best results in bituminous concrete construction is the use in the wearing surface of good, hard, durable stone, free from dirt and decomposed material, as decomposed stone in the mixture will naturally develop weak spots in the pavement and ultimately result in failure.

The penetration of the asphaltic cement used in the mixture should be governed by the character of the traffic requirements.

As before stated, the success of all bituminous concrete and bituminous pavements is very largely dependent upon the rolling, and the best results can be obtained only by using a light roller for the initial compression and a heavier roller for the final compression, with an equal amount of transverse and longitudinal rolling.

In the laying of sheet asphalt or bituminous concrete, where brick gutters are used and adjacent to block runners along car tracks, it is good practice to lay the finished surface of the pavement from one-eighth to one-quarter of an inch higher than the brick gutters or runners. It is difficult in the rolling to secure final compression next to these blocks, and traffic will further compress that portion of the pavement, naturally causing the development of low spots which hold water and result in deterioration.

OVERHEATING CAUSES MANY FAILURES.

Special attention should be paid also to the heating of the various aggregates entering into the pavement and also to the combined mix, as many failures are caused by overheating. No over-heated material should be used under any circumstances, as failure is bound to result.

In vitrified block paving avoid the tendency to place too great a depth of sand-cushion, as latter day experience has proven that the sand working up in the joints has been responsible for many failures, and the success of the pavement is dependent very largely upon the method of mixing and applying the grout filler. The grouting, although a simple proposition, has in many cases been handled so carelessly that the success of a good pavement has been destroyed.

The practice of placing transverse joints in brick pavements appears to be unnecessary, as the curb joints generally will suffice.

In laying wood pavements, care should be taken to see that the wood blocks are properly protected from the elements when delivered on the job and before laying, as too frequently the material is delivered along the line of the work so far ahead of the laying that the blocks dry out, and, after placing, if they become saturated, undue expansion results.

The old road having been resurfaced, its life and success depends upon the maintenance, which in turn depends largely upon attention to details. A patrol maintenance system will do more to preserve roads and pavements, and prevent deterioration, than any one thing.

The trouble in the past has been that the average engineer has been interested only in the construction end of the work, while the most important problem confronting the road engineer of to-day is the rehabilitation and proper maintenance of the old resurfaced roads."

**WILLIAM D. UHLER, Chief Engineer,**
**Pennsylvania State Highway Department**




# Don't Fight Today's Battles With Yesterday's Weapons

**The most successful contractors have either supplanted their old-fashioned horses and wagons with motor trucks or are gradually doing so.**

Read what James A. Mullen of Philadelphia, says of his Garford:

"I have been using one of the large Garfords as well as several other makes of motor vehicle. I find it almost indespensable.

"I have considerable long distance hauling and in instances of this kind it ***supplants five and six double teams.***

"I have about 200 horses in daily use, but this truck appeals very strongly to me and I feel that the Garford will soon usurp the horse method of transportation."

***"Supplants five or six double teams"*** —think of the saving—not only in cost of vehicles but in the wages of drivers as well.

You can operate a Garford Motor Truck just as successfully in ***your*** business.

Our complete line of styles and sizes enables us to offer a Garford to fit exactly the requirements of any business.

Garford Motor Trucks

A few months ago S. M. Williams, sales manager of the Garford Motor Truck Company, distributed several thousand copies of his booklet. "Roads—Their Influence Upon Economic and Social Conditions," among State and county officials, engineers, prominent business men and educators. Since then requests have been received from Good Roads Associations, Chambers of Commerce, and influential business men for over 200,000 copies of this booklet for distribution in good roads campaigns in all sections of the country. Your copy will be mailed on request. Please address Dept. 100.

## The Garford Motor Truck Company, Lima, Ohio

Manufacturers of Trucks of ¾, 1, 1½, 2, 3, 5 and 6 ton capacity

Distributors and Service Stations

New York, Boston, Philadelphia, Baltimore, Pittsburgh, Chicago, Minneapolis
St. Louis, Kansas City, Denver, El Paso, Dallas, Houston, San Francisco, Columbus

"HARRIS PAVERS"
Daily Capacity 40,000
THE HARRIS BRICK COMPANY
Main Office CINCINNATI, OHIO
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"Hydrolene"
Asphalt Products for Road Building are Unsurpassed
Road Binders, Asphaltic Cements, Road Oil
SUN COMPANY
Toledo, Ohio Philadelphia, Pa. Chicago, Ill.

PENNSYLVANIA PORTLAND CEMENT
"For Better Roads and Streets"
PENNSYLVANIA CEMENT COMPANY
30 East 42d Street NEW YORK

McAvoy Vitrified Brick Company
PHILADELPHIA, PA.
"McAVOY BLOCK"

A. H. Blanchard
M. Am. Soc. C. E. M. Can. Soc. C. E.
Consulting Highway Engineer
Broadway and 117th Street New York City

The Garford Motor Truck Company has opened a large branch in Chicago, in charge of a company known as the Garford Motor Truck Company, Inc. The building at Indiana Avenue and Twenty-Third Street, has been secured, and a sales and service department occupies this building, which also houses the business offices. G. A. Crane, formerly manager of the commercial truck department of the Overland Motor Company, is in charge of the new branch.

The business of the Garford Motor Truck Company in the Chicago territory has been growing so rapidly that it was decided to place the business under separate and individual management instead of the former agency arrangement with the Overland Motor Company. C. E. Golder, formerly with the Curtis Automobile Company and the Kissell Motor Company, is assistant manager and in charge of sales. Fred Liser is taking care of special sales work, and was formerly with the Chicago branch of the International Motor Company. J. C. Philpott is in charge of the commercial car service department, having formerly been in charge of this same department with the Overland Motor Company. The above gentlemen, together with a strong sales organization which was brought over by Mr. Crane from his old organization, gives the Garford Motor Car Company an exceptionally strong organization in Chicago, where the use of motor trucks has developed as rapidly as in any other city in the country.

* * *

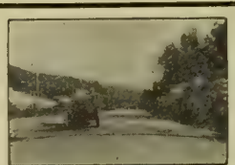
## Reorganization of Rural Engineering

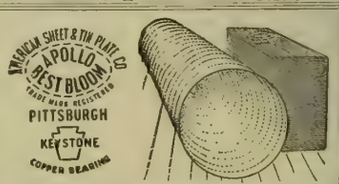
REPORT OF FEDERAL WORK ON PUBLIC ROADS AND IN FARM IRRIGATION, DRAINAGE, AND ARCHITECTURE.

The Annual Report of the Office of Public Roads, which the Department of Agriculture has just issued for the fiscal year ending June 30, 1915, announces the incorporation into the office of the work in farm drainage, irrigation, and architecture. This work was transferred to the Office of Public Roads under the act of Congress dated March 4, 1915, which reorganizes the Department of Agriculture in certain important features. In order that the new organization might be actually under way at the commencement of the fiscal year 1916 the Office of Public Roads took over this new work on April 1. Since that time drainage investigations have been carried on in Florida, in States north of the Ohio River, in Kentucky, and in northern Idaho. Plans for the organization of drainage districts and methods of financing such organizations have also been studied.

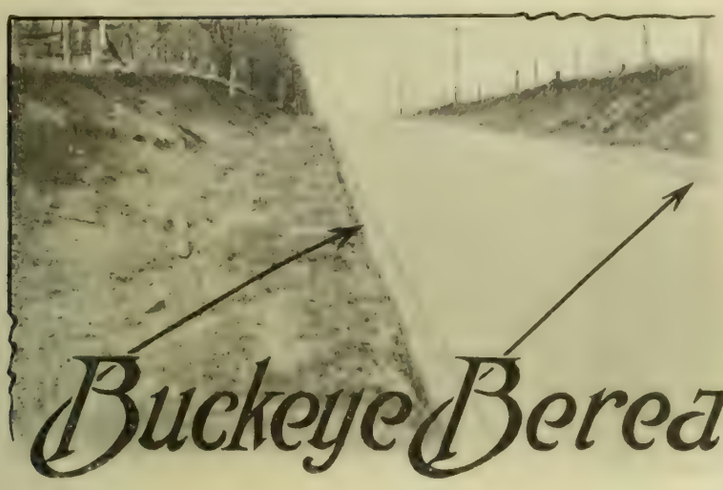
The farm irrigation investigations which were formerly conducted on a territorial basis are now being handled on a subject basis and the local offices which were previously maintained in various States have been abandoned. Hereafter the men will work from three central offices or from Washington.

In its road work the office for the past year has continued to supervise the expenditure of the $500,000 appropriation


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State Highway Commissioner of Connecticut nearly eighteen years.
Advice given on all phases of road building and street paving.
Consultations on specifications, materials and methods. Specialty of recommending efficient and economical equipment and plant Accurate estimates for contractors.

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BEST BLOOM Galvanized Sheets
Made from KEYSTONE COPPER BEARING STEEL—Unequaled for
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as well as for Roofing, Siding, and all forms of exposed sheet metal work. Look for this stencil on Keystone Copper Bearing APOLLO BEST BLOOM Galvanized Sheets—it insures service and satisfaction. You should use no other. Write for full information.
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We manufacture a complete line of Sheet and Tin Mill Products of every description and for every known purpose. Send for interesting booklet showing actual service tests.




**This View shows a** section of the celebrated Akron-Cleveland, Ohio, Road, curbed with "Buckeye Berea" Stone. This road was paved in 1911, and over 20 miles of stone curbing was used. "Buckeye Berea" Natural Sandstone Curbing is not only increasingly popular for residential and business streets, but is being furnished in enormous quantities for permanent County and State Roads.

**"Buckeye Berea" Natural Sandstone Curbing**
**lasts longer than the wearing surface, filler and foundation** of pavements—and without a cent for repair or upkeep! It defies the elements—it is the most economical because it is the most durable.

Send for illustrated "Reasons Why" you should specify "Buckeye Berea" produced by

**The Ohio Quarries Co.** **Cleveland, Ohio**

PERMIT us to express the wish that the New Year may bring you, in both your official and private capacities, all possible success and prosperity. May it be better than any year you have ever had, while being the worst of those ahead.

Permit us also to thank you for the part you have had in making 1915 as successful for us as it has been---our biggest year---and to assure you that we will continue to build the very best that America can produce in the way of mixers. Sincerely yours,

THE JAEGER MACHINE COMPANY
COLUMBUS, OHIO U. S. A.

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A Short Span but Large Area Provided with Half-Sections of

"ACME" (NESTABLE)

Corrugated Anti-Corrosive — Galvanized Culverts

The convenience of these half-sections is well illustrated by this photograph. About the cheapest and most permanent—and altogether satisfactory—manner of eliminating bridge troubles from highways is to make the bridges with "ACME" (Nestable) Corrugated Culverts or to use our Corrugated Flat Bottom Culverts in shallow fills.

"ACMES" are shipped Set-up, where desired, in full-circle or half-circle sections. You'd better have our Catalog G-2.

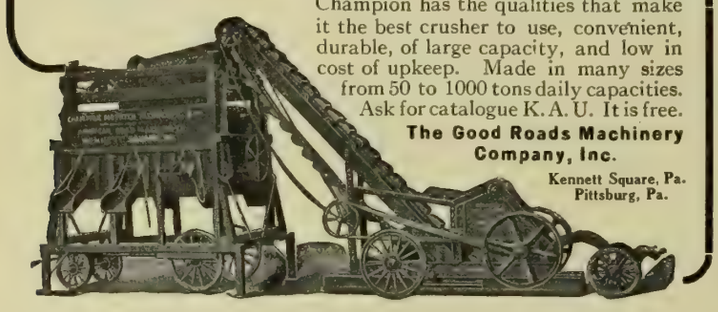
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Champion Mounted Rock Crusher

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The Good Roads Machinery Company, Inc.

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The Sunbury Automatic Car Unloader

Highest Efficiency — Lowest Operating Cost

Absolutely Automatic on Sand, Screenings, Slag, Stone, Small Coal, or Other Loose Material.

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TELL 'EM YOU SAW IT HERE.


which Congress provided the Post Office Department for the improvement of post roads in counties or States contributing double the amount spent by the Federal Government. Five such roads were completed during the year in Iowa, Maryland, Oregon, and Virginia. Work was also continued on eleven other roads being built under this appropriation. Bridges and road systems were also planned for a number of countries throughout the country and advice given to local officials in a large number of States.

The demonstration of maintenance work which the office started last year on the highway from Washington to Atlanta, was continued with much success. Of the 1,000 miles of this highway 723 are now under the supervision of the office. The counties affected are being encouraged to undertake construction where this is necessary, and to maintain the road in good condition elsewhere. Experiments in the maintenance of various kinds of highways have also been conducted in Virginia and Maryland.

One of the most important activities of the office mentioned in the report has been the collection in the past year of data on the mileage of improved and unimproved roads throughout the country and of the expense incurred for road purposes. Traffic studies on a number of important roads have also been made in order to determine the traffic in ton miles before and after improvement. This affords a basis for calculating the amount of money each community may profitably spend upon the improvement of its roads.

Numerous tests of materials used in road building have also been conducted.

* * *

## "Good Roads Day" in Milwaukee

With a banquet at the Hotel Pfister attended by more than five hundred local road boosters and out-of-town guests, following a stupendous automobile parade, Milwaukee County celebrated its annual Good Roads Day on Saturday, November 27, 1915.

Governor E. L. Philipp, of Wisconsin, who headed the speakers' list at the banquet, advocated convict labor and trunk-line roads.

"We have at the State penitentiary more than nine hundred prisoners," said Governor Philipp, "and most of these men would be glad to work in constructing highways.

"Of course, we could not use all of the men, but in many sections prisoners have been contracted for at $1.50 a day with great success. The plan appears to me to be most feasible, and I will ask the next governor of the State of Wisconsin to see that the legislature passes favorably upon the convict-labor plan."

Governor Philipp, in summing up the qualities of good roads, seemed to favor gravel construction. He also advocated the building of trunk lines rather than "piece-mealing" the erecting work.

"In Wisconsin, we find many sections where a few miles of good road have been built only to discover an immediate stretch of roadway almost impassable," said the Governor. "I believe that the erecting of trunk lines is the only successful plan, for in many cases, by the time a community is ready to build a section of road, another stretch has worn out.."

Other prominent speakers were: E. L. Lobdell, Chicago, Ill., president of the Sheridan Road Improvement Association of Illinois; Mayor Bading of Milwaukee; Wm. E. McCarty, chairman of the County Board of Supervisors; District Attorney W. C. Zabel; W. G. Bruce, secretary of the Merchants' and Manufacturers' Association; Ex-Governor F. E. McGovern; J. S. Smith, editor of the Wisconsin Motorist; J. A. Hazelwood, State highway commissioner; W. E. Hamilton, secretary of the Sheridan Road Improvement Association of Wisconsin; W. G. Edens, president of the Associated Roads Associations of Chicago and Cook County; County Highway Commissioner H. J. Kuelling; and many others.

"Good Roads Day" was celebrated under the auspices of the Sheridan Road Improvement Association of Wisconsin and the Milwaukee county boards.

THREE MILES OF AUTOS

The motor parade, in which more than five hundred automobiles and auto trucks participated, was one of the largest

(*Continued top page* 50)

## Decision on Luten Patent Handed Down

(*Continued from page* 35.)

d. The claims under patent number 853,203, on which reliance is placed to establish that the defendants' bridge was an infringement, relate to the reinforcing members in said bridge transverse to the roadway and extending upward into the wall or spandrel near its back face, reinforcing members embedded transverse to the roadway and extending upward into the wall or spandrel and having such transverse members other reinforcing members embedded into wall or railing.

e. The claims under patent number 979,776, on which reliance is placed to establish that the defendants' bridge was an infringement, relate to reinforcing members in the girders in said concrete bridge comprising a lower horizontal tension rod and upper and lower shearing rods, each having a central horizontal part, inclined parts extending outwardly from opposite ends of the central parts, and the horizontal parts extending outwardly from the ends of said inclined parts, the central horizontal part of the lower shearing rod being longer that that of the upper shearing rod, and the horizontal ends of the upper shearing rod being longer than those of the lower shearing rod.

f. The claims under patent number 989,272, on which reliance is placed to establish that the defendants' bridge was an infringement, relate to the use of embedded tension members reinforcing the concrete abutment and the outer concrete rib or girder continuously adjacent to the surfaces opposite the kneebrace, and extending away from said opposite surface of the transverse member intermediate its middle and the kneebrace and other tension members embedded longitudinally through the kneebrace.

On consideration of prior patents and publications introduced by the defendants to meet the separate and several claims, I am unable to rid myself of the firm belief and conclusion that each and all of the complainant's claims were non-patentable at the time he made his several applications, and also at the two times prior to applications when he claims he first, within two years prior to such applications, made practical use of the claimed inventions in those two instances. The prior patents as anticipations and the prior patents and publications as showing the then state of the art lead to the clear conviction that complainant in each instance only then made application of mere mechanical knowledge and skill, and that what he did is in no sense a demonstration of inventive genius. This is also the opinion of the defendants' expert witness.

The complainant as a witness disclaimed that his patents, or any of them, embodied anything beyond or more than placing "the steel in a new way that produces better results in a more efficient form." Now, in a concrete bridge the greatest efficiency is always secured by resisting tension or pull with steel rods. That has been established for half a century; not perhaps with curved tension members, but the basis idea is very old. There is no question about that. But none of complainants' patents in its specification, including drawings and in the claims, gives any specific direction as to just where any of the reinforcing members should be placed. This I suppose would, in each instance, depend upon the maximum load to be carried, the length of the span, and other elements which involve mechanics only, and would necessarily, I assume, be worked out in determining the amount of compression and tension under the established formulas in statics. In a general way the points of greatest stress can be roughly approximated without the use of mathematical tables, but this is centuries old—that is, it is open to common observation, and the fundamental purpose of reinforcing concrete was to strengthen the structure at these points; such a discovery in Luten's day is no evidence of inventive genius.

A bridge girder, for instance, is commonly known to be in compression on its upper side and in tension on its lower side; hence, the greatest necessity for them through the latter region, and if carried continuously through and anchored in the outer face or foot of the abutment, it is but adding the element of suspension in bridge construction, which is old. This but illustrates. The same applies to the other points relied upon in Luten's patents.

The earliest patent relied upon in anticipation against all of the claims is that issued to Francois Coignet in 1869 (No. 88,547), described in the specifications as being improvements in artificial stone, monolithic structures and artificial stone articles, in which the second claim reads: "The introduction, in the body of artificial stones, or in the body of artificial stone monolithic structures, made of agglomerated artificial stone paste, of skeletons, or metallic framework, linked or arranged so as to strengthen the same." That issued to Hinckley (No. 623,904), April 25, 1899, expressly shows the application of tensile strength by carrying the rod continuously well into the abutments, and also the reinforcement of the spandrel or upper girder against outward thrust from the roadway by rods carried upward into it.

The publications cited against each of the patents are voluminous, and both foreign and domestic, and include drawings and plans with descriptions of the same, in which the reinforcing members have been placed both in bridge and other structures so as to meet the strain where it falls in each instance. These publications so cited are too extensive for review and discussion here.

Two patents to Coignet, both issued in 1860, and the one issued to Hinckley, issued in 1899, are cited against all of complainant's patents. A number of other patents are cited by the defendant, some against one of the complainant's patents and some against another. They will not be applied in detail. They consist of one to Cunningham, 1907, four to Parmley, three in 1902, and one in 1904; two to Hennebique issued in 1898, in which the reinforcing bars in beams or girders are shown continuously as one rod in their lower longitudinal part, upwardly deflected part and longitudinal part in the upper surface, and in the specification he says: "It is possible to construct girders resistant in all their parts in a perfect manner to the effects of tension, the effects of compression, the breaking effects and the bending effects, while reducing to a minimum the quantity of iron employed and suppressing or dispensing with iron in the part under compression." There as here, the tension rod in all of its parts rests in the one perpendicular plane. And also patent issued to Sission and Wetmore (No. 124,453), in March, 1872. Hennebique appears to have completely covered all that was inventive in Luten's so-called truss or shearing rod patent, No. 979,776.

I see nothing more than mechanical skill in tying the wings and abutments together, the circular kneebrace in the outer girder with a reinforcing member, binding it to the adjacent abutment and girder and in carrying the transverse member in the roadway into the outer side of the upper spandrel or girder and upward and over the longitudinal reinforcing member in that girder. In view of the Coignet letters and of the prior state of the art as evidenced by his patent and the publications introduced as above noted, he made specific claim to a "metallic framework linked or arranged so as to strengthen the same."

The views above expressed make it unnecessary to consider the defense of non-infringement of some of the claims.

The authorities relied upon will not be cited, but briefs in which they have been noted will be placed with the files.

It is ordered that the bill be dismissed at complainant's costs.

(Signed) ROBERT E. LEWIS,
District Judge.

(Endorsed) 6,129. United States District Court, District of Colorado. Daniel B. Luten vs. George Washburn, et. al. Opinion, Lewis, District Judge; Filed November 13, 1915.

* * *

One of the most attractive and interesting bulletins which ever came off a printing-press is "Facts, Figures, and Photos," found in Bulletin S-14, issued by the Erie Steam Shovels, Ball Engine Company, Erie, Pa., and copy of it will be mailed free to all those applying for it by letter or postcard request. The steam shovel is now of more general use than ever before and no contractor can afford to be without one. This bulletin contains a number of interesting photographs together with data relative to the Erie Shovel engaged in various classes of work.



White Good Roads Truck which saved $65 per day hauling crushed stone and pulling asphalt penetration tanks

By supplanting thirty horses, nine dump wagons, and ten men, employed in asphalt-concrete road construction, a saving of $65 per day was made by one White Good Roads truck, one trailer and a Lee portable loader on a contract of Thomas Levene at Griffith, Illinois.

This performance not only demonstrated the need of a careful analysis of hauling conditions before substituting motor trucks for horses but also emphasized the value of equipment which reduces the time consumed in loading and unloading operations.

Not only was the motor truck used in a novel and effective way, but the method of construction and the equipment employed was an innovation in asphalt-concrete work. It was witnessed by the officials of not less than twenty-five counties, a number of highway engineers and two contractors, A. L. Courtright and Downey & Portz who, with Mr. Levene, had developed and built at joint expense three asphalt penetration tanks used in this work.

The job was two and one-fourth miles from a railroad siding, where asphalt was received in tank cars and stone arrived in rock cars. In addition to the White Good Roads Truck, the equipment consisted of a Lee portable loader, a three-yard trailer, three horse-drawn asphalt penetration tanks of 600 gallons capacity each and a steam tractor for heating up the asphalt in the storage tank and for furnishing compressed air to force the flow from the tank car to horse-drawn tanks.

The road was built thirty feet wide on a foundation of six inches of slag and with a slag shoulder. On this slag there was laid and rolled three inches of two-inch stone, after which the asphalt was applied under a pressure of twenty-five pounds and at a temperature of 320 to 340 degrees.

This penetration spreading process possesses the advantage of forcing the asphalt down into the crevices of stone. Gangs of men with wheelbarrows and shovels followed close behind the tank wagon, shovel-spreading chip stone over the hot asphalt. As these men moved along the road, a steam roller, only a few yards behind them, forced the chip rock into the crevices of the two-inch rock, which crevices had already been thoroughly impregnated with asphalt, forming a waterproof binding.

Later the above operation was repeated except that screenings were shovel-spread on the asphalt and in turn rolled into the crevices of chip rock and bound, thus forming a waterproof surface of three sizes of rock perfectly bound by asphalt.

The new process developed by these three contractors is both simple and efficient. In addition, the utilization of the penetration tanks in repair work is far superior to the customary hand-pouring of asphalt, inasmuch as the flexible outlet and nozzle makes it possible to apply the asphalt to the entire width of the road in one operation.

In the pulling of the three penetration tanks, the motor truck showed an important economy, to say nothing of the stone that was hauled by the truck and trailer. Each of the tank wagons, when loaded, weighed about 16,000 pounds and, when drawn by horses, required two teams. Three of these tanks were necessary to keep the shovel crews busy. While one tank was being loaded at the base and another was being unloaded on the road, the third tank was in transit to the job.

When horses were used to draw the tanks, their progress was so slow that two men were required to each tank wagon, the driver being unable to leave his seat for the necessary wood-firing of the heater. It was also necessary to have three teams with two-yard dump wagons follow each of the tank wagons because the shovel crew required from six to eight yards of either screenings or chips for each 600 gallons of asphalt that was spread. Thus each tank unit required two teams to pull the tank and three other teams to follow with stone. For the fifteen teams there were required twelve drivers and three firers.

By using a Lee portable unloader at the rock cars and cutting down the time of loading operations, the contractors were able to have the truck and trailer pick up the empty and full asphalt tanks as fast as the work progressed, making the four and one-half mile round trip in a little less than one hour, including coupling and uncoupling delays. The faster speed of the truck also rendered unnecessary the services of a firer.

Four men were assigned to the rock cars to shovel into the loading bins and by reason of the fact that they could shovel during the absence of the truck and trailer, having the load ready the minute the truck appeared, they were enabled to shovel as many yards daily as were formerly shoveled by nine-team drivers who had spent the greater part of their time in comparative idleness on the wagons between the rock cars and the dumping point. These operations therefore show a net saving of fifteen teams and ten men, as follows:

| 3 Penetration Tanks, 9 Dump Wagons. | | 1 White Truck, 1 Trailer, and 1 Portable Loader. | |
|---|---|---|---|
| 4 horses to each tank...12 horses | | 4 shov'l'rs at loader | 4 men |
| 1 driver to each tank.... | 3 men | 1 driver for truck.. | 1 man |
| 1 firer to each tank.... | 3 men | | |
| 2 horses to each wagon..18 horses | | | |
| 1 driver to each wagon.. | 9 men | | |
| 30 horses | 15 men | | 5 men |

Mr. Levene figures that in supplanting thirty horses and ten men the truck saved him $65 per day, on the basis of $3 per day for each team and $2 per day for each of the ten men. Considering the investment in a White Good Roads Truck at $5,700, and one of the Lee loaders at approximately $800, this equipment, at a saving of $65 per day, would pay for itself in 100 working days, or a short summer's work for any progressive road contractor.





# *The* WHITE *Good Roads* TRUCK *Grades, Hauls, Spreads, Rolls, Every Road Making Operation At A Saving*

The White Good Roads Truck pulls the heaviest grader or drag, carts the road material, dumps it, spreads it and rolls it. This complete, compact, cost-cutting road-builder makes highways three times as fast, twice as good, at one-half the cost.

Louis Martine, Road Contractor, of La Porte, Indiana, built a macadam roadway with the White Good Roads Truck at 13½ cents a yard for hauling, spreading and rolling—the crushed stone was hauled a distance of 2 to 2½ miles a round trip. Mr. Martine says with horse-drawn machinery and teams carting the cost was 35 cents a yard. He estimates that his two White Good Roads Trucks save $55 a day.

L. A. Waddington, Chairman of the Commissioners of Cabarrus County, North Carolina, said his commission would rather have two of these road-making trucks than a $400,000 bond issue. If you are a contractor, an engineer or a municipal, county or state official and interested in road making, it will pay you to investigate the dollar-saving features of the White Good Roads Truck.

## Here Is What A White Good Roads Truck Can Do For You

The broad-gauge wheels of the White Good Roads Truck enables it to operate on soft, fresh-made surfaces or in pits where snatch-teams would be needed for horse-drawn vehicles

It will haul five tons of material and dump each load by power in 30 seconds, spreading the load at the same time if required

Pulls two of the heaviest graders 40 miles a day

Pulls a 16,000-pound drag, covering a road width of 36 feet, 50 miles a day

Packs and rolls the surface with its broad-gauge steel wheels

Pulls trailers where conditions are suitable

Transports gangs, tools and supplies

Withstands severe and continuous service

Reduces the labor cost by reducing the number of drivers and helpers

Supplants the traction engine, runs faster, does more work a day and turns on ordinary roads

Simplifies work by reducing the number of hauling units

Operates on ground too soft and wet for traction engines or mules

Pulls gang-ploughs, disc-harrows, etc.

Does more work at less cost than an outfit of mules of the same investment

Smooth, wide-faced wheels do not injure road surfaces

Crosses bridges that would not support the concentrated weight of the traction engine or the road roller

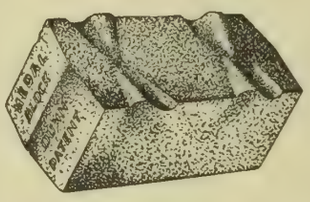
*Write for full particulars*

## THE WHITE COMPANY, CLEVELAND, OHIO

*White Trucks Received the ONLY GRAND PRIZE for motor trucks at the Panama-Pacific International Exposition*

"Best Paving Block Made"
"METROPOLITAN"
Wire-Cut Lug Paving Block
MADE OF
Canton, Ohio, Shale
The Metropolitan Paving Brick Co.
Canton, Ohio

BESSEMER LIMESTONE COMPANY
Manufacturers of
Bessemer Repressed and
Wire - Cut Lug Block
(DUNN PATENT)
YOUNGSTOWN, - - - - OHIO

THE DECKMAN-DUTY BRICK CO.
CLEVELAND, OHIO
Manufacturers of

Repressed
and Wire-Cut Lug
"Medal" Block
The Block that ENDURES and ENDURANCE Means QUALITY.
HILLSIDE BLOCK ALWAYS IN STOCK

OUR WIRE-CUT LUG BRICK is the acme of perfection for street paving material.
Write us for samples and prices.
CLINTON PAVING BRICK COMPANY
CLINTON, INDIANA

TELL 'EM YOU SAW IT HERE.

auto parades ever held in the State. The cars stretched over a distance of more than three miles.

At Devil's Elbow, where the last mile of concrete roadway completing Milwaukee County's share of the Sheridan Road course has been completed, Miss Antoinette Smith, three-year-old daughter of Ray Smith, president of the Sheridan Road Improvement Association of Wisconsin, christened the highway by breaking a bottle of Lake Michigan water on the concrete.

Mayors Charles Franke, of South Milwaukee, and Christ Woehsner, of Cudahy, then shook hands and cut a ribbon stretched across the road allowing the long parade to pass by.

The slogan of the day, so far, at least, as the local people were concerned, was, "Milwaukee County, the Good Roads Capital of America." They are "making the bluff good" with a program which adds over forty miles to the county system of permanently improved roads every year. With the work of the past year, the county now boasts of one hundred miles of concrete and sheet asphalt roads, all from sixteen to forty feet wide.

* * *

## Gasoline Hauling Locomotive

**PHELAN & SULLIVAN**
**GENERAL CONTRACTORS**
JOHN AND CATHARINE STS. UTICA, N. Y.

Syracuse, N.Y., Oct. 3, 1915

J. D. Fate Company
Plymouth, Ohio

Gentlemen:--

Replying to your letter of recent date asking our views on two locomotives purchased from you early last month for use on our State Highway Contract # 1072 Syracuse Bridgeport Road, we beg to advise that to date the machines have given perfect satisfaction and are doing everything that we expect of them and more than you guaranteed.

We are hauling gravel on a 24" gauge railway and at present are hauling a distance of two and one-quarter miles. The machines make ten trips each per day with nine one and one-half yard cars, making a total of two hundred and seventy cubic yards of gravel per day. The cost of operation is $13.50 which includes two Runners at $2.50 each and two Brakemen at $2.00 each, twenty gallons of gasoline and one gallon of oil, which makes the total cost of the haul of approximately two and one-quarter miles 5¢ per cubic yard. We have two slight grades on this haul of approximately 1% and we have hauled twelve loaded cars up these grades without giving the locomotives any apparent strain

We are enclosing some views taken of these locomotives on the work which will give you an idea of the manner in which we are using these machines and trust they will be of some value to you.

We cannot say toomuch in recommendation of these locomotives and would be glad to have you refer any inquiries regarding them for this class of work to us.

Very truly yours,
PHELAN & SULLIVAN
(SIGNED) Per L D Sullivan

LDS / S



(Continued on page 52)

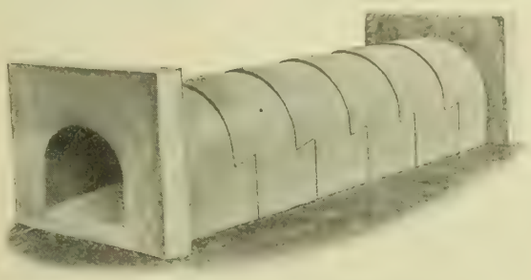
# Keeping Two Jumps AHEAD of the Other Fellow—that's Success

CORRODING, makeshift culverts of wood, iron or "wrinkled tin" have lost favor—it's Concrete for Permanence now. From 2000 to 5000 culverts are needed in every county. Tax payers are spending Big Money for Permanent Road Drainage; they are entitled to receive Permanent Culverts.

Pouring Concrete Culverts on the job costs too much; half the money is spent in traveling back and forth, hauling materials and ***getting ready to commence to start to do something,*** to say nothing of blocking the roadway. That's why more than 40% of our correspondence is from Engineers, men who see that our contractors don't waste a dime's worth of time, labor, haulage, or materials. - - - - - - - - -

***Economical*** because made in contractor's shop. No pouring on the job. Two men set in one day.

***Permanent*** because reinforced concrete, no iron pipes, rods, or hooks needed to join sections.



THE CULVERT EVERLASTING

***Flexible*** because additional sections can be added quickly in case road is widened. Larger size can be substituted, if needed, without wasting.

***Profitable*** because our contract makes it so.

***Reliable Engineers and Contractors only*** are desired as local manufacturers. Only one concern in a county or district. Our Exclusive Contract keeps up the Standard of the Product.

Keeping two jumps ahead means doing it now, getting ready for culvert needs of 1916 before the other fellow is ready to figure. Send for our Folder giving 15 Reasons Why. This culvert is not a substitute for anything. It is the Perfection of Engineering Design, Economy, and Service.

## SCHULZ & HODGSON

—DISTRIBUTORS—

HALL INTERLOCKING CONCRETE CULVERT

19 South LaSalle Street, CHICAGO

***Meet Us at the Cement Show***







* * *

The construction of proper guard rail fences requires the use of concrete or metal posts, for timber is not available and concrete posts cannot be made with the use of post forms.



The accompanying illustration shows concrete guard rail fence posts on which were used the post forms manufactured and sold by the Hotchkiss Lock Metal Form Co., Binghamton, N. Y.

* * *

## A New Road Planer, Grader and Ditcher

An entirely new type of road machine, known as the Zindorf Good Roads Planer, Grader, and Ditcher, has been put on the market, the principal features of which will be briefly described herewith. The even and horizontal plane of travel is not, as in nearly all other road machines, disturbed by the roughness of the ground over which it is working. The machine moves forward only and is not reversible. Owing to the construction of the machine, it cuts the high places and automatically crowns and levels the roadbed. In others words, it is a true planer.

The illustration shown herewith gives a very fair idea of how the machine works, the photograph showing some grading work under way in the State of Washington. The planing is accomplished by the long frame, or landslide, as it is termed, to which is fastened a plow at the front and a mole-board twelve feet long is hinged to this plow. This mole-board is adjustable as to the width it will cut, and is also adjustable as to the crown or degree of slope that is required for the road bed. The landslide is so arranged that a perfect line may be had, and an even, horizontal position is acquired automatically. It may actually be compared to the carpenter's plane which cuts off the high places on a board but which misses the low ones.

The operator on the machine has little to do, and what he has to do to operate the machine to secure the greatest speed



Zindorf Good Roads Planer, Grader and Ditcher

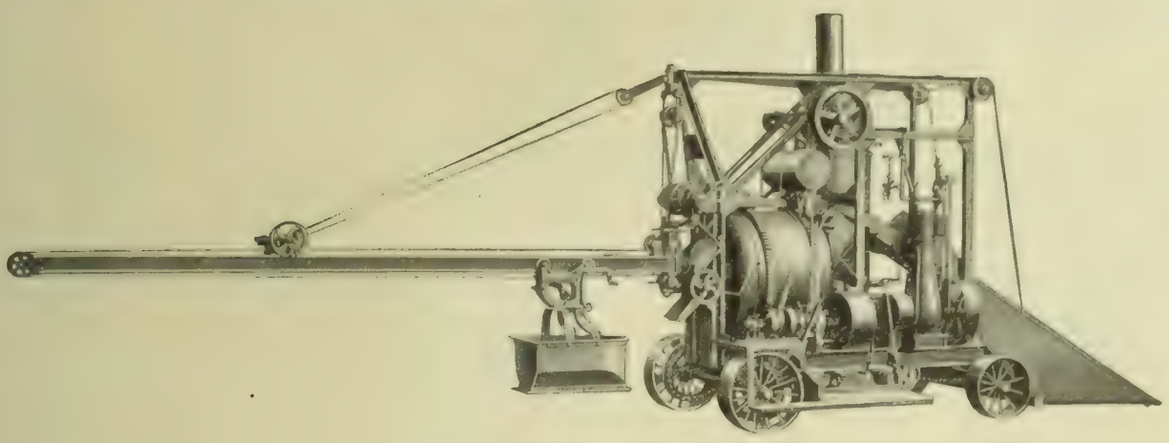
and efficiency is very simple. He need not be an experienced man, as a laborer can easily operate the machine on any kind of work. His work consists principally in raising the point of the plow out of the ground when it advances into a long depression which does not require cutting. This is done by pulling the plow lever back two or three notches, requiring but a fraction of a second. The plow is lowered by simply releasing a catch.

The new grader has five wheels that carry it over the ground, but they do not disturb the even horizontal plane as they travel on the already leveled ground where it has been planed by the machine. Four horses are used to draw it in trimming up roads, while six are required to operate it in new road construction where the work is heavy. In the construction of a new roadway, this machine will handle with ease three thousand cubic yards of material in an eight-hour day with six horses, the driver, and the operator of the machine.

The draft is so arranged that the machine follows the near horse. When the near horse walks in the side ditch, the machine will clean the ditch and move the material toward the center of the road, where it can be removed by team or otherwise. When operated this way, a true straight line and an even grade and crown to the road is certain. It is easily and instantly adjustable to any condition that may be met, and is of sufficient strength to withstand the rough work with which such a machine has to contend. It has been used in highway construction and irrigation work by the inventor, who is a well-known contractor, he having worked the machine out to facillitate work on his own contracts. In this way, during the seven years that he has used it, he has given it the severest kind of tests, and has tried it out on every kind of work which the highway contractor, the county commissioner, or the supervisor of roads would be called upon to perform.

The new machine is manufactured by M. P. Zindorf, Alaska Building, Seattle, Washington.

# "So much for So much"



"So much for so much"—it's the law you can't evade.

*Quality costs just so much.*

With the big factory facilities, and the big volume of business, Koehring prices represent *quality* — and the smallest amount of overhead per machine.

You will find this Koehring quality right with you on every job—in the more *automatic features which save time, and labor costs, and increase yardage.*

—in the extra *safety-margin* of construction which means consistent yardage, day after day, season after season, without the money-loss of delays due to breakdowns.

"So much for so much"—the *quality* mixer is the *cheapest* in the end—the *Koehring.*

# KOEHRING

Here is a suggestion—*how about a combination cement concrete mixer and hot mixer for bituminous materials?*

The Koehring hot mixers are readily convertible for cement concrete work.

—or you can get a Koehring mixer for cement concrete and later get hot mixer attachments.

**Koehring Capacities**

Side Loaders: Nos. 4, 7, 10, 12, 15, 20, 24, 30, 44.

Pavers: Nos. 6, 11, 16, 22.

Hot Mixers: Nos. 12, 16, 20, 22.

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## KOEHRING MACHINE CO., Milwaukee, Wis.

**Sales and Service Offices in All Principal Cities**

# Boys May Come and




# Boys May Go




# But the Sign Stays There Forever

Made of Rust Resisting Iron "Armco" (American Ingot Iron) The Most Durable Iron Manufactured.




**The letters are drilled into the plate, then filled with bright aluminum and cannot be erased.**



"THE SIGNS THAT OUTLIVE FATHER TIME"

For prices and other information write, or call and see us.

**THE INDESTRUCTIBLE SIGN CO.**

528 Dennison Avenue COLUMBUS, OHIO

TELL 'EM YOU SAW IT HERE.


# Specifications for Guide Signs

Designed and Prescribed by

The State Highway Department of Ohio

The guide sign shall bear the name of the town, distance in miles, and indicate the direction thereto by means of an arrow or hand. The sign shall be made of iron, and shall be finished in a workmanlike manner, making the sign easy to read, pleasing in appearance, and permanent.

## DETAILS

METAL: The body of the sign shall be a plate not thinner than 12 gauge stock when constructed of a single plate, and not thinner than 18 gauge when reinforced with heavier metal along the edges.

CHARACTERS: The letters, figures, and arrow or hand, shall be countersunk or raised about 1/16 inch. In case mounted characters are used, they shall be securely fastened to the body of the sign in such a way as to not interfere with the legibility of the sign.

TYPE: The letters and figures shall be about 2½ inches high, neatly and accurately formed and spaced. Types of letters similar to the designs attached herewith will be acceptable.

PAINT: All metal shall be free from rust or scale and shall have all its surfaces thoroughly coated with a durable paint or enamel, evenly spread. The letters shall be white and the background black, or vice versa. Aluminum may be substituted for the white. Mounted letters shall be painted on both sides. No mixing or over-running of colors will be allowed.

FASTENING: The sign shall be provided with suitable means for securely fastening it to a post.

POSTS: Posts may be of iron or any timber of lasting quality, neatly dressed and firmly set in the ground to a depth of not less than two and one-half feet. The sign shall be securely fastened to the post about six feet above the ground.

CLINTON COWEN,
State Highway Commissioner.

Columbus, Ohio, November, 1915.


*The Indestructible Sign*

COMPLIES WITH THE

***SPECIFICATIONS***

OF THE

**STATE HIGHWAY COMMISSIONER OF OHIO**

AND SHOULD BE USED BY ALL STATES

## A Sweeping Change in the Engineering Force of the State Highway Department

(*Continued from page 4.*)

In District Number 4, with headquarters at Franklin, H. W. Claybaugh remains as Assistant Engineer in charge. Jefferson County has been withdrawn from this district and has been added to the newly created engineering district.

District Number 5, comprising Berks, Schuylkill, Carbon, Northampton, and Lehigh counties, remains as it is but W. R. Wolfinger, who has been Assistant Engineer in charge of District Number 9, with headquarters at Chambersburg, is transferred to District Number 5, with headquarters at Allentown, succeeding John T. Gephart, Jr., Engineer of Construction, who has been temporarily in charge of this district. Mr. Gephart returns to the Harrisburg office to assume his duties as Engineer of Construction.

District Number 6, with headquarters at York, retains W. A. VanDuzer, as Assistant Engineer in charge and the county superintendents are unchanged. The same is true of District Number 7, with headquarters at Philadelphia, where W. F. Cressman remains as the Assistant Engineer in charge with the same county superintendents.

The newly created District, Number 8, will have its headquarters at Clearfield and will include Clearfield, Indiana, Jefferson, Elk, and Cameron counties. The Engineer in charge will be F. E. Winter, who has been a resident engineer in charge of inspection at Warren, Pennsylvania, and who is promoted to the post of Acting Assistant Engineer. Mr. Winter is a graduate of Pennsylvania State College, and has been with the State Highway Department four years. The county superintendents in this new district remain the same.

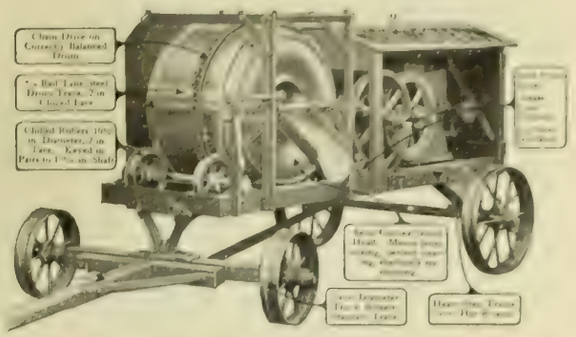
In District Number 9, with headquarters at Chambersburg, where W. R. Wolfinger, transferred to Allentown, has been in charge, W. S. Hammaker, County Superintendent of Cumberland County, is promoted to the post of Acting Assistant Engineer in charge of the district. Mr. Hammaker is succeeded as county superintendent of Adams and Cumberland counties by W. B. Fleming, who has been General Foreman and Acting Superintendent in Adams County.

District Number 10, with headquarters at Wellsboro, remains in charge of J. S. Ritchey as Assistant Engineer but loses Sullivan and Cameron counties; Sullivan County being transferred to District Number 3 and Cameron County to the new District Number 8. W. H. Hatfield, who has been County Superintendent of Potter and Tioga counties, retains Tioga County and J. W. Frazier, who has been a draftsman at District Number 4, is promoted to the superintendency of Potter County.

In District Number 11, with headquarters at Hollidaysburg, C. S. Lemon remains as Assistant Engineer. Huntingdon County is withdrawn from this district and becomes a part of District Number 1. The superintendents remain the same


**Get This Big $250.00 Mixer $185.00**

***Satisfaction Guaranteed***



**Northwestern 5-Foot Mixer Only $185.00**

Built Complete in Northwestern Factory

**WRITE FOR FREE BOOK NO. 15 ON CONCRETE MIXING**

Also Get Our Easy Payment Plan with full particulars of the machine here shown and larger sizes.

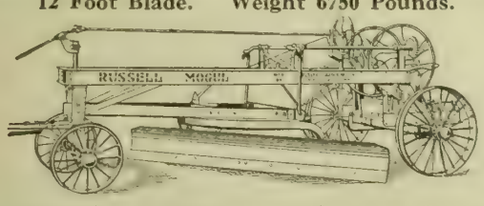
**Northwestern Steel & Iron Works** EAU CLAIRE, WISCONSIN

CAPITAL $200,000.00

**SEE OUR EXHIBIT AT CEMENT SHOW**

**THE RUSSELL "MOGUL"**

12 Foot Blade. Weight 6750 Pounds.

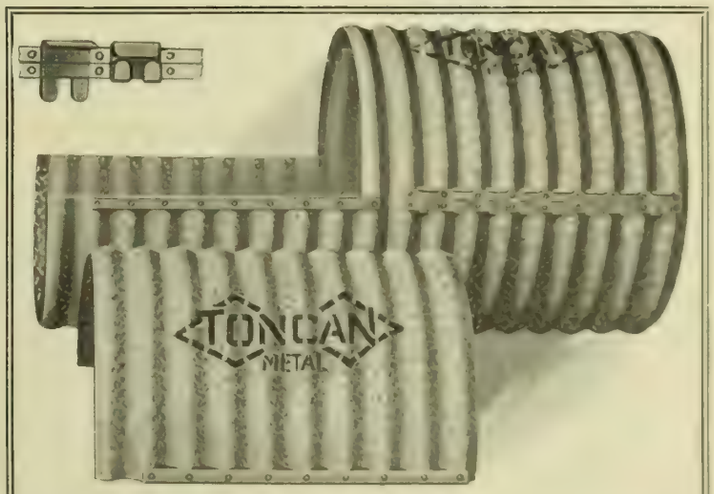



The largest capacity and strongest road machine made. For tractor power only. Stands the "gaff" of 60 H.P. machines. Very easily operated. Reversible. For big work it has no equal.

We Make a Full Line of Road Machinery for Every Size Job. Write for Catalogue.

**RUSSELL GRADER MANUFACTURING CO.,**

MINNEAPOLIS, MINN. Representatives In All Principal Cities.




***Here's Real Culvert Economy***

The real economical culvert is rust-resisting, non-breakable, easy to transport, install and remove, low in cost and maintenance.

Such a culvert is the

BUTT-JOINT NESTABLE CULVERT

*Made from*

Rust-Resisting TONCAN METAL Anti-Corrosive

SHEETS

Consider carefully the advantages of the Butt-Joint Nestable Toncan Metal Culvert. IT REPRESENTS TRUE ECONOMY.

*Write for Catalog*

**THE BUTT-JOINT NESTABLE CULVERT CO.**

826-828 REEDY STREET CINCINNATI, OHIO

## The Whalen Form, Mfd. by Concrete Form Company, Inc., Syracuse, N. Y.

1 December 1915

Mr. Jesse Taylor, Editor,
Better Roads & Streets,
Jamestown, Ohio.

Dear Mr. Taylor:-

Since the formation of our company we have advertised in various mediums for dealers and for customers, and insofar, as getting orders as a result of advertising to the trade, we have come to the conclusion, that it is impossible. Simply keeps our name before the public, and get us inquiries from those interested and curious people, who are referred to our representatives.

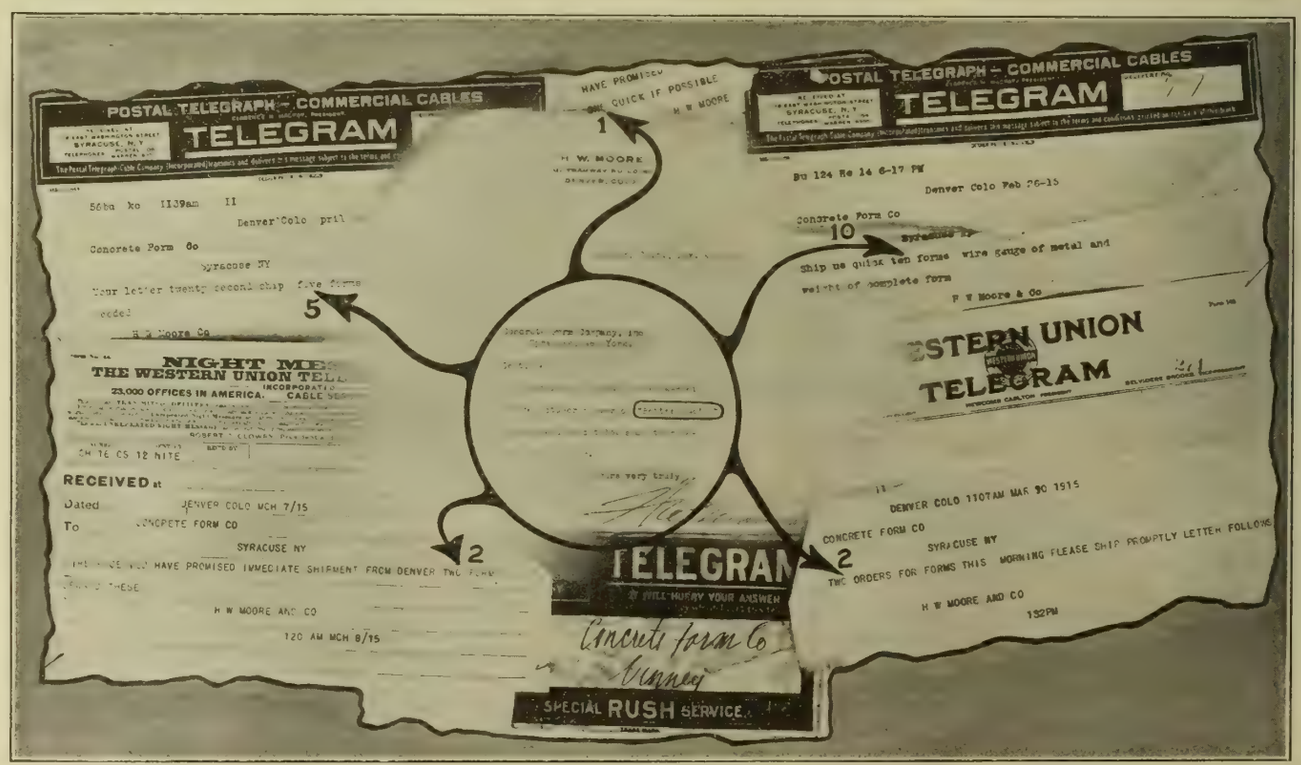
However, we have found that the results from Better Roads and Streets, have been much better than any other trade paper we have ever advertised in, it apparently reaching the best class of trade, and this is proved by the halftone illustration of our results with Mr. Moore at Denver, who answered our advertisement in Nov. 1914, and we believe that the best results in advertising for dealers can only be obtained in Better Roads and Streets.

We therefore feel justifed in stating that the best trade paper in this country for the purpose is yours, and we believe that every advertiser should give this fact careful consideration.

We remain,

Very sincerely yours,
CONCRETE FORM COMPANY INC.
BY A. L. Feenaughty
SALES MANAGER

THE WHALEN FORM



except in the case of Huntingdon County where Mr. Closkey succeeds T. J. Strickler.

In District Number 12, with headquarters at Scranton, P. M. Tebbs remains as Assistant Engineer and the counties remain as heretofore, the only change in this district being that of J. G. English, who has been a transitman at District Number 7, with headquarters in Philadelphia, and who is promoted to the superintendency of Wayne County.

In District Number 13, with headquarters at Pittsburgh, S. W. Jackson remains in charge and the county superintendents are unchanged.

District Number 14, with headquarters at Washington, remains in charge of A. B. Gray as Assistant Engineer. H. B. Stevens is removed as County Superintendent of Fayette County and is succeeded by E. L. Clemmer, who has been an Inspector of Construction and who is promoted to the superintendency of this county.

In District Number 15, with headquarters at Warren, T. C. Frame remains as Assistant Engineer in charge but Elk County is withdrawn to become a part of the newly created district. G. O. Lindley, former County Superintendent for McKean and Elk counties, goes to the new district as Superintendent of Elk County and Cameron County, being succeeded in McKean County by H. S. Wood, who has been a Chief of Construction in District Number 15 and who is promoted to the superintendency of this county.

* * *

## State Highway Officials Demand One Convention

(*Continued from page 6.*)

other road problems and road economics concluded the evening's interesting program.

FINAL SESSION.

The third session was called to order on Wednesday morning, W. S. Kellar, of Alabama, presiding.

President Shirley was first on the program, having been assigned the subject, "Patrol System in Road Maintenance." Without any prepared paper, Mr. Shirley gave a talk fairly bristling with valuable ideas showing how, with the proper organization, roads may be maintained under a very heavy traffic so that resurfacing or rebuilding will rarely, if ever, be necessary. One of the salient points brought out by Mr. Shirley was that politics and patrol will not mix successfully; in other words, that maintenance by the patrol system is so dependent upon the individual patrolman that only those who have a genuine interest in their work can be relied upon to keep the roads in proper shape.

Clinton Cowan, State Highway Commissioner of Ohio, had, to say the least, quite a comprehensive subject to cover in "Uniformity of Road Laws and Signs; Classification of Motor Vehicles and Systems of Traffic Census." However, with a fund of information to draw from in the way of recent rules, regulations, and investigations made and carried on under his direction in Ohio, Mr. Cowan presented a paper which was listened to with interest by other commissioners who also have the serious problems of non-uniformity in local traffic regulations and signs to contend with.

The final address of the meeting was given by Joseph Hyde Pratt, on the subject, "Road Publication and Publicity." Mr. Pratt emphasized the need of educating the people by all means at the command of the highway departments, on the need of good roads and the methods for obtaining them. Pamphlets issued by the department and a systematic campaign in the newspapers and periodicals have been a part of the publicity scheme worked out with great success by Mr. Pratt in North Carolina.

RESOLUTIONS.

The remainder of the session was given over to business, the first to come up being the resolutions demanding one road congress as outlined above.

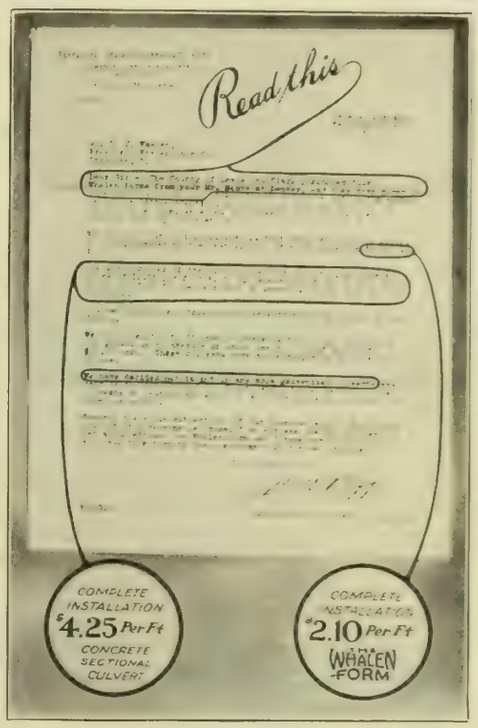
The report of the Resolution Committee composed of S. E. Bradt, of Illinois, A. R. Hirst, of Wisconsin, and D. J. Smith, of Florida, submitted the following:

*Resolved,* That we favor the Federal aid in highway construction along the lines indicated in the bill prepared by this Association believing that such aid will prove to be of great benefit not only from the standpoint of financial assistance, but also in standardizing the work of the different States.


The Whalen Form Won World's Highest Award for Concrete Highway Culverts Panama-Pacific Exposition



*The Reason is*




YOU DON'T BUY THE PIECES

Jobbers Wanted

YOU BUILD A CULVERT

THE WHALEN FORM

Syracuse, New York

CUT CULVERT COST TO THE LAST CENT

TELL 'EM YOU SAW IT HERE.

*Resolved*, That we favor the holding of one and only one National Road Congress annually and that the annual meeting of this Association be held at the same place, either immediately preceding or following the date of said congress.

*Resolved*, That we as an Association as well as individual members thereof use our best endeavor in bringing about a more economic and efficient expenditure of highway moneys, and that we urge the appointment of all National, State, and local highway officials on the basis of merit free from political control, in order that the public may have greater confidence in the proper use of said fund.

*Resolved*, That we hereby extend our thanks to the Association Roads Organization of Cook County for the courtesies shown this Association and its various members.

Respectfully submitted,
S. E. BRADT, Illinois.
A. R. HIRST, Wisconsin.
D. J. SMITH, Florida.

ELECTION OF OFFICERS.

The election of officers resulted in one ballot being cast for the following slate (stars denoting re-election):

President, Henry G. Shirley*, Chief Engineer of Maryland, Baltimore, Maryland.

Vice President, A. B. Fletcher*, Highway Engineer of California, Sacramento, California.

Secretary, Joseph Hyde Pratt*, State Engineer of North Carolina, Chapel Hill, North Carolina.

Treasurer, F. F. Rogers*, State Highway Commissioner of Michigan, Lansing, Michigan.

Executive Committee: Chairman, George P. Coleman* (re-elected for five years), Richmond, Virginia; Wm D. Sohier*, of Massachusetts, Thos. H. McDonald*, of Iowa; E. A. Stevens*, of New Jersey; Lamar Cobb*, of Arizona.

Finance Committee: Chairman, S. E. Bradt*, of Illinois; W. S. Keller*, of Alabama; Paul D. Sargent*, of Maine; W. S. Gearhart, of Kansas.

This concluded the regular sessions, though most of the members stayed over for the final feature provided by the local people, an automobile trip out over Milwaukee Road, one of the recently completed, concrete, State-aid highways, to The House That Jack Built, where refreshments and entertainment were provided for the visitors by the hospitable Associated Roads Organizations.

* * *

## West Virginia School of Good Roads

(*Continued from page* 15.)

the State to avail themselves of the assistance of their institutions in the solution of their problems.

It is necessary that the standards of all courses be maintained in conferring degrees, but special courses are available at various times and the university seeks to be of real service to all the people of the State.

Besides the regular staff of the university, men of high reputation have been secured to assist in making the short course on roads the most valuable the limited time will permit. Lantern slides, moving pictures, actual tests and demonstrations, will illustrate many of the lectures so as to make them as instructive as possible. The work will be taken up in systematic order. The forenoon of each day of the first week will be devoted to study and lecture periods, and those expecting to attend are requested to read and prepare on the subject of grades and alignment, road planning and location, drainage, culverts, earth and sand-clay roads, road economics and economical design of roads and pavements, types and kinds of highway bridges, bridge floors and paints, gravel, macadam, Tarvia, asphaltic concrete, concrete and brick road construction, cost accounting, uniform methods of accounting, uniform plans and specifications, standards and standardizing of road materials, equipment and methods of construction, prison labor and camp equipment, and highway maintenance. Information upon these subjects will be found in the bulletins issued by the State Road Bureau which can be had upon application.

*The Third Annual Session of the School of Good Roads will be held at the West Virginia University, Mechanical Hall, January* 11-21, 1916.

---

The question of road improvement calls for organization. Organization that will produce efficiency can be had and should be had in every county. The work should be under one head and that person should know daily what is being done, how much is being expended, where the work is being executed, the number of laborers and teams employed, and the amount and kind of material used, as well as the cost of each.

---

Good roads are a benefit to any and every community. They help the school, the church, the Sunday school, the farm, the liveryman, the doctor, the traveling salesman, the wholesaleman, the teacher, the preacher, and even the undertaker can get to the cemetery easier and better if he has a good road.

Good roads save in shoe-shine and clothes-cleaning bills in many instances more than would be our share in taxes to get the good roads.

---

A system of good roads in West Virginia should bring $50,000,000 from tourists and save $50,000,000 more in food stuffs.

---

The man on the farm needs a good, firm, well-drained road that he can use at any and all seasons of the year.

---

Too many roads have been built "as father did" and stand to-day as monuments of ignorance and folly or have been swallowed up by the mud and water.

---

Bad roads and idle farms; bad roads and poor churches; bad roads and poor schools; bad roads and no social life; bad roads and discontment; bad roads and high cost of living. Good roads and fertile farms; good roads and good church attendance; good roads and good school attendance; good roads and good social enjoyment; good roads and contentment; good roads and better living at less expense. Give us good roads! Good roads! Good roads! And more good roads!!!

---

Farmers who do not want to take their wives and families over bumpety roads and make them disgusted every time they go to church or town, should drag the roads and see to it that they freeze up as smooth as possible this winter.

* * *

## Large Manufacturers Take Positive Stand

(*Continued from page* 16.)

road engineers and road authorities in the country to prepare papers for presentation. It has been a noticeable fact during the past four years, that there has been but a slight variation in the subjects discussed and in the speakers at the respective congresses of the American Road Builders' Association and the American Highway Association. Authors would put more time on the preparation of their papers and bring out many little-discussed subjects if they felt that the one big national road congress would be the only one in which they would be asked to participate each year, and this would make the sessions far more interesting and attractive to road authorities than they have ever been. Taking all these things into consideration, is not the proper procedure in the future to support either no road congresses of so-called national scope, or to support heartily one large, really national congress?

* * *

## Public Road Improvement in Canada

(*Continued from page* 7.)

one, Ottawa to Prescott, passing along the Rideau River and through the counties of Carleton and Grenville and the village of Kemptville; the other, Ottawa to Morrisburg, through Carleton and Dundas Counties and the village of Winchester. The decision of the route rests with the provincial government, with the city of Ottawa, and with the municipalities interested. The votes of the municipalities between Ottawa and the St. Lawrence, being each in favor of their own respective routes, would naturally cancel each other, and the choice would be left to Ottawa and to the provincial government represented by the deputy minister of highways at Toronto.

COMPETITION FOR THE ROAD.

The adherents of Morrisburg and Prescott are now active, through inspection, tourist's banquets, council debates, etc., in advancing the merits of their respective towns for a terminus.



## Forty Miles From a Railroad

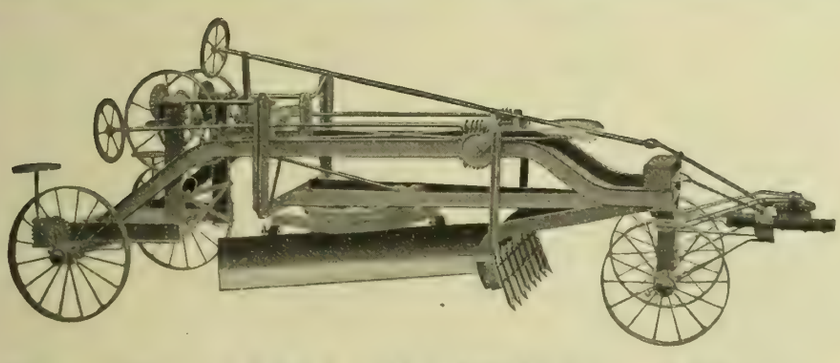
The illustration shows a 72 inch diameter, 12 gauge Armco Iron Culvert which is being installed in Box Elder County, Utah, at a point forty miles from the nearest railroad station.

# ARMCO AMERICAN INGOT IRON CULVERTS

are convenient to handle and install, strong and reliable, and *lasting* because of the unequalled purity and evenness of their material.

For full information on Armco Corrugated Culverts (full and part circle) Siphons, Sheets, Roofing, and formed products, write

**Armco Iron Culvert Publicity Bureau** — **Cincinnati, Ohio**



PANAMA LINE ROAD MACHINERY

The "Panama Line" Road Machinery has been for a number of years widely known for its splendid mechanical perfection, low prices and efficiency. The line is so complete that practically all wants can be fulfilled. Only the best of materials are used and the most skilled mechanics employed. Buyers of "Panama Line" Machinery are assured satisfaction.

## The "PANAMA GIANT" Road Machine with Scarifier

Is the most perfect and practical Road Grader, having the widest possible range of uses. The easiest of any machine to operate. First Cost, considering its mechanical excellence, is very low. Longer service than the average machine at a lower up-keep expense. The Scarifier is always in position for instant adjustment. Can be used in conjunction with blade or drawn up out of the way.

Do not decide upon any Road Machinery until you have seen the "Panama Line" catalog.

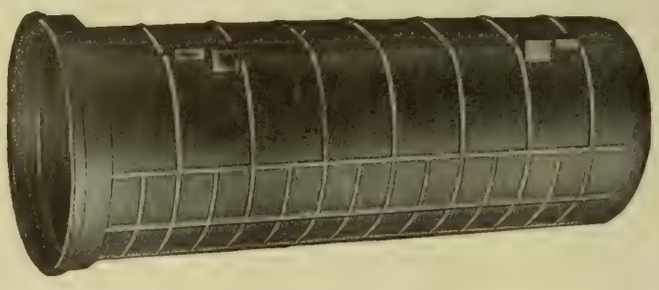
*Write for Catalog Today.*

**THE F. B. ZIEG MANUFACTURING COMPANY FREDERICKTOWN, OHIO U.S.A.**

# SAVE TIME—SAVE MONEY

USE THE

## Burch Expansion Cast Iron Culvert Pipe



8 to 48 inches diameter, 3 and 4 ft. lengths.
Half sections which lock with lugs.

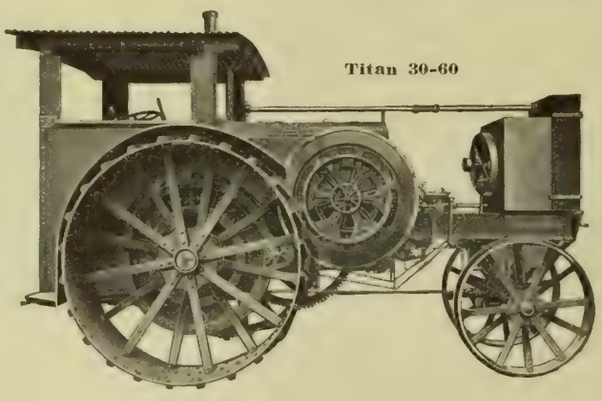
Provides for expansion and contraction. Easy to handle and lay in ditch. Requires less excavation. Strong and durable. Send for Catalog "F" giving full description of complete line.

## THE BURCH PLOW WORKS CO.

CRESTLINE, OHIO



## Kerosene Power Cheapest for Road Work




How much more money would you make for yourself or for your community if you found a way to cut 25 per cent. off your present cost of grading roads? If you are still using horse or mule power, we can show you a way to save even more than that. If you are using a gasoline tractor, we can still show you how to make a profitable saving.

Every dollar you cut the cost of road grading is a dollar added to your net profit. We can put you in touch with one man who says he cut the cost of road grading in Louisiana from $26.00 PER MILE with mule power to $4.50 PER MILE with MOGUL kerosene tractor power. His figures are in the official records of his parish.

That is probably an extreme case, but the fact that so large a saving as this could be made, is interesting. It suggests that possibly your costs are higher than they need be. Perhaps a little investigation would pay. Would you like to see some of the figures we have collected—some of the savings we have helped other contractors and road builders to make by changing over to MOGUL or TITAN kerosene tractor power? They'll cost nothing but a two cent stamp and a little time. Write for them.

## International Harvester Company of America

(Incorporated)

152 Harvester Building CHICAGO, U. S. A.


TELL 'EM YOU SAW IT HERE.

The Morrisburg parties claim that there is a better farming community between Ottawa and Morrisburg than between Ottawa and Prescott, and that the distance from Ottawa to Morrisburg (42 miles) is 16 miles shorter than from Ottawa to Prescott, which shorter distance at $10,000 a mile represents a saving of $160,000. They also call attention to the fact that Morrisburg has no railroad connection with Ottawa, whereas its neighboring towns (Prescott, Brockville, and Cornwall) have such connection; and that Morrisburg was the home of the late Premier Whitney, who led the enactment of the recent provincial good roads legislation, and for whom the road is to be named.

The Prescott claimants, while not admitting all the contentions of the Morrisburgers, are emphasizing the superior ferry facilities from Prescott across the St. Lawrence. A regular and reliable ferry service, practically the year around, for both passengers and automobiles is available from Prescott to Ogdensburg, New Yory—a thriving city. The St. Lawrence River between Prescott and Ogdensburg is unobstructed by islands, and at and near Ogdensburg are some of the good roads for which New York State is noted, all of which appeals to automobile tourists.

The New York town across from Morrisburg, Ontario, is Waddington, much smaller than Ogdensburg; and, while Waddington is also connected with good New York roads, the river there is obstructed by islands, and the ferry service consequently not very good.

This superiority in ferry service from Prescott and the influence of prominent men in Prescott, Ogdensburg, and Ottawa will, it is believed, bring about a decision in favor of the Prescott route.

Perhaps a compromise can be reached whereby the road will take in both places. It is thought possible to combine the advantages of the two routes by having the highway run from Ottawa to Morrisburg and thence from Morrisburg to Prescott, thus including a stretch of 20 miles along the St. Lawrence. If the calculation of the Morrisburgers as to distance is correct, such a looping route would be only four miles longer than from Ottawa direct to Prescott.

The people of Cornwall and vicinity are, of course, interested in having the Whitney Memorial Road take in Morrisburg, for then there would be a fine road available to Ottawa and the United States from Cornwall, 20 miles nearer than at Prescott. Moveover, if Morrisburg were the terminus of of a first-class road, then the improvement of the road from Cornwall to Morrisburg (about 25 miles), either as a main highway or as a county road system, would doubtless be agitated.

FORERUNNER OF GOOD ROADS—ADVICE TO AMERICAN MANUFACTURERS.

A first-class stone road between Hamilton and Toronto is, through special legislation, now nearing completion. If, by virtue of the broad legislation set forth above, Ontario embarks upon the expected extensive program of highway construction, not many years will elapse before the several stretches of good roads along Lake Ontario and the St. Lawrence River will form a continuous boulevard between Toronto and Montreal.

Parties in the United States interested in the sale of road-building implements for the construction of the Ottawa-St. Lawrence road should communicate with the Department of Public Roads and Highways, Toronto, Ontario, where can doubtless be obtained information as to probable needs and purchasers. Very likely the board of trustees in charge of the road construction will also have a voice in any purchases; but, as above stated, this board will not be appointed until after January 1, 1916, when the legislation authorizing the Whitney Memorial Road is to be proclaimed. (Commerce Reports No. 264, November 10, 1915.)

* * *

## Public Co-operation in Highway Work

(*Continued from page* 8.)

the construction of feeders from the more remote districts into these great main highways. And these feeders will have to be built.

"This will, naturally, mean a slight increase in their road tax, but the taxpayers will be willing to pay it as soon as they

are educated to realize that it means only a temporary investment, and that it will all come back to them with increased valuation of their properties, with better living conditions and with the greater possibilities from the many people who will then be drawn from the cities to enjoy the country life and all the advantages that such life brings with it.

"In the final analysis, when the State Highway Department has the active co-operation of the interests named, the people, the press, the automobile clubs, and others, a bond issue will be carried almost unanimously for the necessary amount, whether it be one million dollars or fifty million dollars. These bonds will then only be issued as required to make payments and, in a few years, Pennsylvania will have a system of the best roads that are to be found in any State in the United States, and will stand out pre-eminently as an example for all other States to follow."

* * *

## First Traffic Census of the Central Business District of Chicago

(*Continued from page* 10.)

Figures taken at ten points between LaSalle and Market streets, Randolph to Van Buren streets:

| | | |
|---|---|---|
| Horse-drawn Vehicles— | | |
| Wagons, all kinds | 16,161 | 46.05 |
| Carriages | 213 | .65 |
| Buggies | 423 | 1.26 |
| Motor-driven Vehicles— | | |
| Auto trucks | 2,848 | 7.53 |
| Two-seated autos | 2,411 | 6.15 |
| Four or more seated autos | 10,870 | 26.27 |
| Street cars | 5,556 | 12.09 |
| Totals | 38,482 | 100.00 |

Figures taken at ten points south of Van Buren Street:

| | | |
|---|---|---|
| Horse-drawn Vehicles— | | |
| Wagons of all kinds | 22,825 | 59.17 |
| Carriages | 42 | .11 |
| Buggies | 265 | .69 |
| Motor-driven Vehicles— | | |
| Auto trucks | 5,099 | 13.22 |
| Two-seated autos | 716 | 1.85 |
| Four or more seated autos | 2,835 | 7.35 |
| Street cars | 6,793 | 17.61 |
| Totals | 38,575 | 100.00 |

GENERAL TOTALS AND CLASSIFICATION.

Vehicles used for commercial purposes in the cartage of freight and other commodities totaled 100,727.

| | *Per Cent.* |
|---|---|
| Horse drawn | 82.21 |
| Trucks of all kinds | 17.78 |

Of carriages, buggies, and automobiles used for business and pleasure purposes, the total was 59,950.

| | *Per Cent.* |
|---|---|
| Carriages | .86 |
| Buggies | 2.23 |
| Two-seated autos | 19.16 |
| Four or more seated autos | 77.74 |
| Carriages and buggies | 3.09 |
| Automobiles | 96.91 |

Street cars as counted numbered 26,995.

Traffic was distributed as follows:

| | *Per Cent.* |
|---|---|
| Horse-drawn vehicles | 45.12 |
| Moter-driven vehicles other than street cars | 40.50 |
| Street cars | 14.38 |
| | 100.00 |
| Average number of vehicles per hour | 257.79 |
| Total number of hours | 728. |

TYPES OF PAVEMENT.

There are four types of pavement found in the business district where the census was taken, creosoted block, asphalt,

CAREY Elastite JOINT

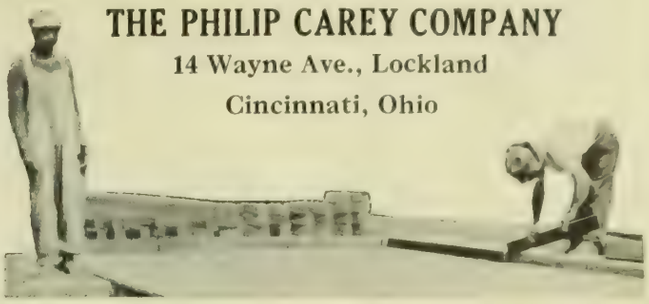
FOR all types of paving, for concrete bridges, viaducts, reservoirs, stadia, etc., wherever allowance must be made for expansion and contraction, ELASTITE saves time, labor and expense and gives a better job.

ELASTITE consists of a heavy body of special asphalt compound between two layers of high-grade asphalt felt, the whole being firmly bonded together to form a continuous section of any desired dimensions.

Instead of using wooden spacing strips and then coming back to remove them and pour the joints, merely place ELASTITE strips *and leave them,* thus keeping your work all *in front* of your gang.

*FOR FREE SAMPLE AND LITERATURE ADDRESS*

**THE PHILIP CAREY COMPANY**
**14 Wayne Ave., Lockland**
**Cincinnati, Ohio**



**Doesn't This Pretty Nearly Answer to What *You* Want in a Steam Roller?**

This letter which came recently from a customer at Rushville, Indiana, pretty nearly measures up, we think, to the dimensions of a good testimonial.

Please read it, and see if doesn't credit "New Huber" Road Rollers and Scarifiers with having about all the good features YOU would expect to buy:—

*"We have used your roller and scarifier the entire summer, and found it capable of tearing up old macadam roads easily and successfully.*

*The roller is easy to handle, has plenty of reserve power, cheap on fuel, and being short, can be turned around on a narrower grade than any roller we have seen. We like it."*

**If So, Why Not Write Us NOW About A "New Huber" For Your Own Work?**

It's none too soon to be thinking now about what you're going to do this spring and summer. Our catalogs and literature will interest you, and the machines themselves will interest you still more.

We shall be glad for you to arrange a trip here to Marion to inspect our machines and their work. Complete and interesting details will be gladly furnished you upon request.



THE HUBER MFG. CO.

*Road Rollers and Scarifiers, Gas Tractors and Steam Engines, Threshing Machines, etc.*

Station 6
MARION - OHIO

TELL 'EM YOU SAW IT HERE.

# Build Macadam Roads

The macadam road is gaining favor each day.

It is the oldest and best class of road construction in Europe and America.

Thousands of dollars are being spent annually to promote Brick and Concrete Roads, BUT BEAR IN MIND THAT A BRICK ROAD COSTS MORE THAN TWICE AS MUCH AS MACADAM and Concrete increases the cost nearly one-half and neither will wear any longer than a high standard Macadam Road.

Figure the total cost of each road covering a period of twenty years or longer and you will adopt macadam.

Get the facts before adopting your specifications.

Write us for information on stone and slag macadam, water-bound, or treated with asphalt or tar.

We can make delivery of crushed stone or slag in all parts of Northern Ohio, Eastern Ohio, Northern Indiana, and Southern Michigan.

## THE FRANCE STONE CO.

TOLEDO, OHIO

General Office: Second National Bank Bldg.



## Keep The Crews Busy This Winter

THE problem of how to continue road construction during cold weather finds a solution in many cases

BY USING THE

**Low-Freezing Explosives**

made by the Du Pont Company. A few explosions of Red Cross Powders will loosen the frozen top soil, shatter stumps or boulders, open a ditch, smash a culvert, dig post holes or other work along the highway. No thawing is necessary except in near zero weather, if Red Cross Low Freezing Powders are used to keep your crews busy this winter.

FOR INSTRUCTIVE BOOKLET ABOUT USING EXPLOSIVES IN ROAD-BUILDING, WRITE FOR "ROAD CONSTRUCTION AND MAINTENANCE."

**E. I. du Pont de Nemours and Company**

Wilmington, Delaware

Powder Makers Since 1802



TELL 'EM YOU SAW IT HERE.


granite block, and brick. Creosoted block, with a lesser amount of asphalt, predominate in the retail and financial districts, while granite block are used largely in the wholesale district except for a practically negligible yardage of brick.

* * *

## First Paving Mixer to Work in Chicago's Congested Loop District

(*Continued from page* 14.)

*Top Dressing.* Immediately after the filling of the joints, the surface of the pavement shall be covered to a depth of one-quarter (¼) inch with screened, hot, torpedo sand.

HEADERS.

At the end of each intersecting street and alley wing there shall be placed a "header" extending from curb to curb, and so dressed as to conform to the crown of the pavement. The "header" shall be constructed of three by twelve (3 x 12) inch oak plank, properly supported by six-inch split cedar posts three (3) feet in length, firmly set in the ground and spaced not more than five (5) feet apart. When concrete is used as a foundation the "headers" must be set prior to the laying of the concrete. All "headers" shall be constructed by the contractor and the cost thereof shall be included in the price bid per square yard for the pavement.

The blocks were furnished by the Ayer & Lord Tie Company, Chicago. The asphaltic filler was furnished by The R. F. Conway Company, being the brand known as Montezuma, manufactured by the Warner-Quinlan Asphalt Company.

The creosoted blocks were all laid during the day time. Some time ago an experiment was made in laying blocks at night, but it was found that the artificial illumination could not be diffused sufficiently to show up all irregularities, so the practice was discontinued.

The laying of the 9,000 square yards of blocks took, in all, ten days or an average of 900 square yards per day, 100 square yards per hour. The work was completed on November 13, 1915.

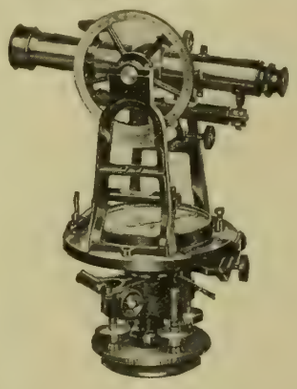
Contractor was the Ryan Company, Chicago, Illinois; the engineer directly in charge, John F. Mathews, Jr., Division Engineer, Board of Local Improvements, city of Chicago.

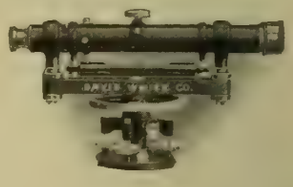
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## Surveying Instruments Designed for Road Builders

The David White Company, Milwaukee, Wis., have recently put on the market a new transit, especially adapted to road work, and also a level similarly designed with the needs of road builders in view. Cuts of the two instruments are shown herewith.

The transit is a light reconnoissance instrument, smaller than the standard-sized transit, but sufficiently accurate for practically all road work, the horizontal limb 5 3-16 inches in



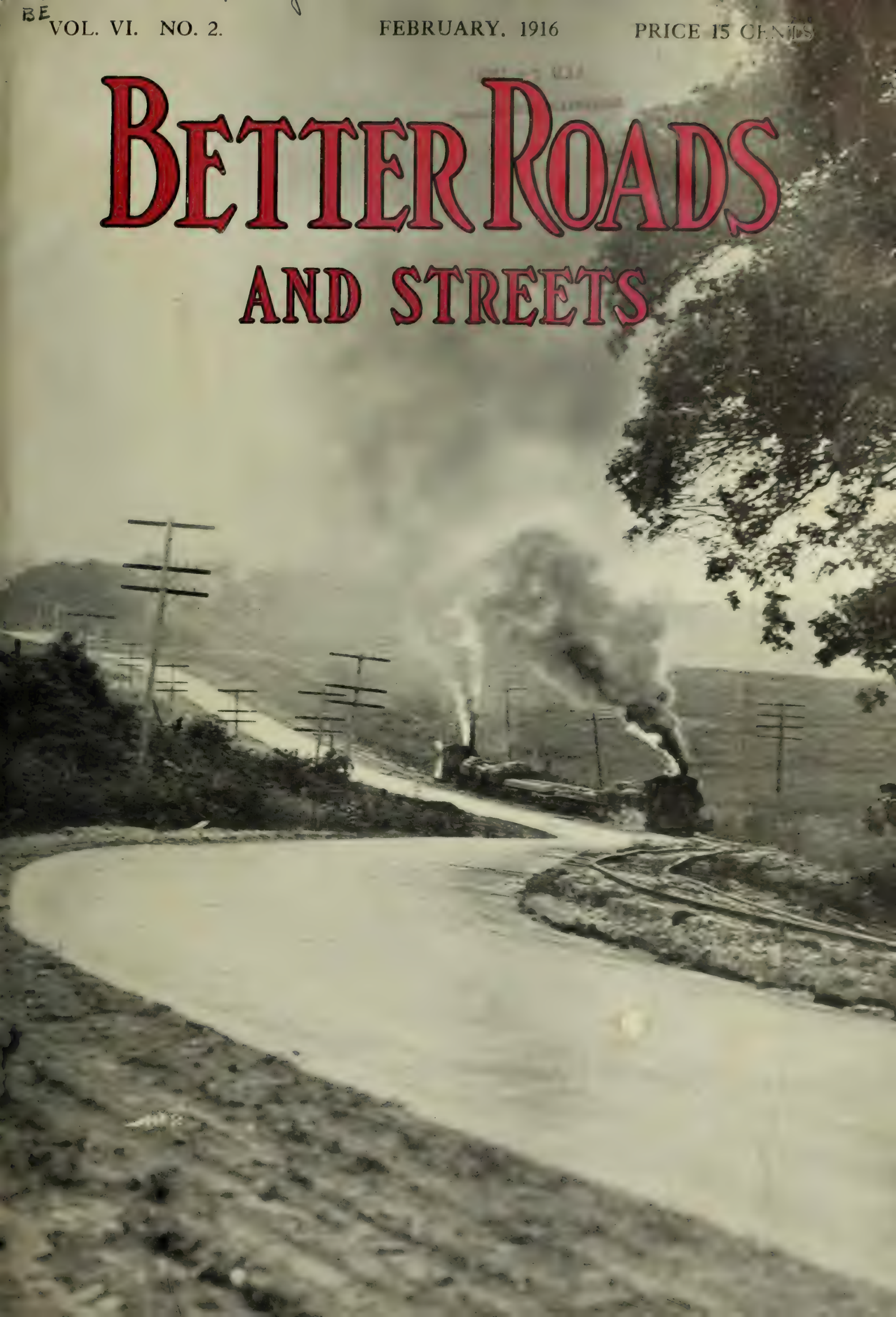


diameter, being divided to one-half degrees with one vernier reading to single minutes. A four-and-one-eighth-inch full vertical circle is similarly divided and reads to single minutes. Similar instruments, but without the vertical circle and compass, are also made.

The road builders' level is of the "Dumpy" type, needing fewer and less frequent adjustments than the "Y" type. The "Dumpy" has always been the favorite with road men. The telescope is twelve inches long with magnifying power of twenty-five diameters.

BE VOL. VI. NO. 2. FEBRUARY, 1916 PRICE 15 CENTS

# BETTER ROADS AND STREETS






Liquid Asphalt Distributer owned by Fayette County, Kentucky

# WHITE
# GOOD ROADS EQUIPMENT

THE cost of building or maintaining a road depends largely upon the equipment that is used. Without modern machinery, a large part of every road fund is wasted. When up-to-date equipment is used every mile of road costs less and is built faster.

The White Good Roads Truck combines the work of hauling, dumping, spreading and rolling road material as well as pulling graders, levelers, drags, scarifiers and trailers. All of these operations can be done quickest and best with a White Good Roads Truck.

Another valuable unit for road maintenance is the White Combination Sprinkler, Flusher and Asphalt Distributer. This apparatus consists of a 1200-gallon tank for either water or liquid asphalt, sprinkler nozzles, flusher nozzles, heating plant to keep the asphalt in a fluid state and a set of distributer nozzles.

With these two road builders, the County of Fayette, Kentucky, during the past season, rebuilt 22½ miles of worn-out macadam on seven different roads, hauled 5882 tons of material, built 30 concrete bridges, laid 8,000 feet of culverts, distributed 80,000 gallons of liquid asphalt in surface-treating about 25 miles of road and in all, reduced the cost of hauling to the remarkable figure of $0.046 per ton mile.



Good Roads Truck pulling a scarifier to break up the old road surface



Good Roads Truck hauling two trailers with crushed rock besides its own load

THE WHITE COMPANY

CLEVELAND

*Awarded the only GRAND PRIZE for Motor Trucks at the Panama-Pacific International Exposition*

Engineering Library

# Better Roads and Streets

VOL. VI. NO. 2 FEBRUARY, 1916 PRICE FIFTEEN CENTS

## Twenty-Seven Cement Companies Join in Educational Exhibit at the Ninth Chicago Cement Show

CONCRETE has come into use in engineering work at a rapid rate, due to its adaptibility to a great many forms of construction. Twenty years ago wooden sidewalks were the rule. To-day common practice dictates concrete. The same has or may become true in many other fields. Certainly concrete has gained recognition in the paving field. Five years ago the concrete road was almost a curiosity. To-day it is one of the standard types of construction.

The architect fights shy of using concrete where it is exposed, feeling that as a frame it is suitable but as a means of decoration it is lacking. But this belief is not shared by all and the feeling is now beginning to be heard that concrete used for structural, frame and exterior work marks a true development in bulding, a logical use of a single material for strength and beauty.

The ramifications of its use along these lines have been many and it has been the aim of the twenty-seven cement companies shipping into the district within 500 miles of Chicago to show in their joint space at the Chicago Cement Show, the best present day applications of concrete.

Naturally such an exhibit cannot be made by means of photographs alone. Full sized duplicates have been obtained of the balustrade used in Grant Park, Chicago, which represents the highest in architectural design in its various features; of highly carved decorative panels in the Hollenden Hotel, Cleveland; of the United States Army seal, deeply carved in concrete; of building stone, now largely used in the East, of concrete simulating finest of the granites and marble quarried in this country and abroad.

Walls will be shown sufficiently great in extent to demonstrate the appearance of large areas of concrete. Some will be finished by washing to expose colored aggregates, while others will be finished by bush-hammering and rubbing.

The necessity for greater care on the part of contractors in using clean, well-graded aggregates will be treated broadly. A gravel washing and screening device will be operated. A 200,000-pound testing machine will be operated at intervals of an hour to show the greater strength of cylinders of clean as against dirty materials, and of graded aggregates as against ungraded.

The operations of the rural contractor will be shown with the idea of giving the small town contractor a realization of the opportunities that exist in every farming community for profitable work in the construction of silos, barns, milk houses, and dwellings.

Typical concrete products will be shown from many of the best factories of the country, showing what may be done and what should be the aim of cement products manufacturers.

But the most important and impressive exhibit will probably be that devoted to concrete roads, streets, and alleys. The United States Government has just shipped back its models from the Panama-Pacific Exposition, some of which are of exceeding interest to road men. One will be on exhibition, showing every step in the building of a concrete highway.

There will be a model of an alley. On one side will be shown the conditions which normally follow the paving with concrete, including clean back yards, adequate provision for garbage and an order of neatness which is impossible where the alley is not paved. The other side will show the typical bad conditions which of necessity follow the careless method of leaving the alley unpaved. The back yards are unkempt. Garbage and ashes are ill disposed of, and, in general, pride on the part of the property owner is not in evidence.

In addition there will be full-sized pavement sections showing good practice in the placing and finishing of joints and also bad practice. The latter is of equal importance to road inspectors and contractors, as it must be the constant aim of all road men to avoid errors of construction in order that the roads may be permanent and smooth.

These models will permit much knowledge of good and bad construction to be gained by a short inspection, whereas the same amount of information could otherwise only be obtained by many miles of travel and close study of roads.

There will also be a concrete slab showing the various repairs which are necessary from time to time in concrete pavements in order that the road may give maximum service. To illustrate this fully, many charts will be used, also photographs showing good practice. Detailed Illinois cost data on concrete road maintenance will be shown in a striking manner.

The Lincoln Highway, that great demonstration of the wisdom of tying the country together by uninterrupted roads will be shown on a big map which will give the location of all permanently improved strips.

Specimens of pavement will be shown from LeMars, Iowa, where a half block of concrete pavement has been down on one of the main business streets for eleven years; from Bellefontaine, Ohio, where twenty-two year old concrete pavements surround the court house, and from Woodward Avenue, Wayne County Michigan, which has stood seven years of traffic.

The exhibit as a whole will be promotive of the broader and better use of concrete and will leave the companies in the background so far as possible, because the industry is best served by education along these lines.

This joint exhibit furnishes the most novel feature of the Ninth Annual Cement Show compared with those held in previous years. But there are others.

Those who have attended past shows need not be told what a variety of concrete mixers may be seen and compared, nor that there will be exhibits of all other machinery and appliances used in pavement work where concrete enters into the construction, whether as a base, wearing surface, or curb. But at the Ninth Show there will be on exhibition many kinds of contractors' equipment more remotely connected with concrete construction.

Principal among these might be mentioned a large exhibit of motor trucks, which are now playing such an important part in all kinds of road work. The Austin-Western Road Machinery Company furnishes another striking example of a manufacturer whose machinery is used on general road work rather than on a specific type, but who will nevertheless exhibit at the show.

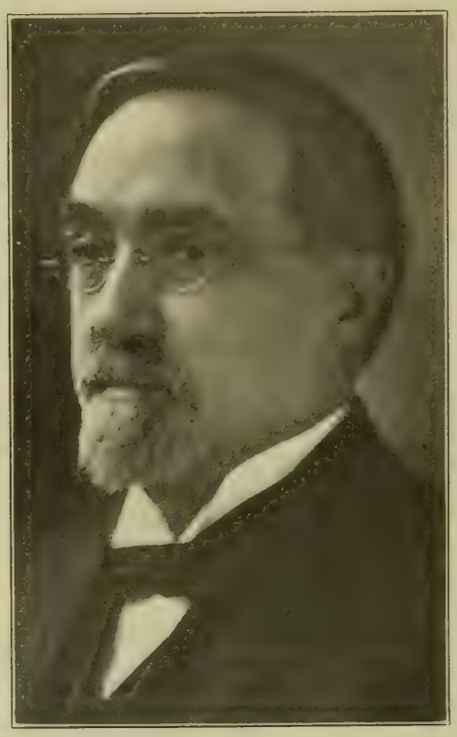
In fact, there were so many more applicants for space this year than previously, that, for the first time in its history, the show management was compelled to hire the First Regiment Armory in addition to the Coliseum in order that all might exhibit. And it will be more of a road show than ever.

Remember the date—February 13-19, 1916.

# Some of the Committeemen Who Will Present Reports at the Second National Conference on Concrete Road Building



HECTOR J. HUGHES, Chairman,
School of Engineering, Massachusetts Institute of Technology and Harvard University, Cambridge, Mass. Chairman of Committee No. 1, Drainage and Preparation of Subgrade.



IRA O. BAKER,
Professor of Civil Engineering, University of Illinois, Urbana, Ill. Chairman of Committee No. 3, Problems of Design, Thickness, Crown and Grade.



JOHN J. COX,
Assistant Professor of Civil Engineering, University of Michigan, Ann Arbor, Mich. Chairman of Committee No. 2, Economical Widths of Pavement and Shoulders.



W. A. McLEAN,
Engineer of Highways, Department of Public Works of Ontario, Toronto, Ont. Member of Committee No. 12, Finishing and Curing.



CHARLES F. SHOOP,
Assistant Professor of Experimental Engineering, University of Minnesota, Minneapolis, Minn. Member of Committee No. 4, Aggregates.



T. R. AGG,
Professor in Charge of Highway Engineering, Iowa State College, Ames, Iowa. Chairman of Committee No. 5, Handling and Hauling Materials and Water Supply.



GEORGE A. RICKER,
Highway Engineer, Albany, N. Y. Chairman of Committee No. 10, Joint Location and Construction.

# Vermilion County, Illinois, Blazes the Trail

BY a decision of the Supreme Court of Illinois handed down on December 22, 1915, the validity of the $1,500,000 bond issue in Vermilion County, Illinois, was finally upheld. This means that the last legal barrier in the way of the county's 175-mile hard road program has been removed and construction work can commence at the very beginning of this year's road building season.

The plan for the bond issue dates back to the summer of 1914 or earlier when sentiment in the county was aroused by a systematic campaign of education by a number of public spirited citizens. The proposition was placed on the regular November, 1914, ballot and carried by a substantial majority.

Then began the (unfortunately) customary long journey through the courts.

At times during the lengthy legal fight it appeared very doubtful whether the expressed will of the voters would prevail but after a year's time all points were finally settled in favor of the county.

Some of the legal decisions are of considerable interest.

One of the big contentions brought up in the suit to restrain the bond issue was that accrued interest should be taken into consideration in computing the taxing limit of five per cent. of the value of the taxable property in the county. Interest on the $1,500,000 bond issue for twenty years would amount to $570,000 which, if the objectors' contention was correct, would bring the amount at issue up to $2,070,000. The assessed value in the county is $36,402,538, and, therefore, under the legal five per cent. tax limit, the bonded indebtedness could not exceed $1,820,126.

Attorneys for the board of supervisors contended that accruing interest should not be taken into consideration, and the court held this view of the matter. Had the board been in error in the matter of exceeding the tax limit, it would have been a constitutional error that could not have been corrected by legislation.

Attorneys for the objectors also contended before the Supreme Court that the county board had no power to issue bonds for the purpose of building roads, and they also contended that the county was not aiding in building roads but was building an entire system of roads. Attorneys for the board contended that the roads had already been built by the various townships and that the board was only building a strip of permanent roadway in the center of the road; that the bridges to be left as they were and that even the gravel on the roads was to be used in the making of the new roads.

The favorable decision of the Supreme Court means much, not only to Vermilion County but to practically every other county in Illinois. Bond issues are being seriously considered this year in nearly one-fourth of the counties of the State and in a few the movement has made such headway that bond issue elections are to be held in April.

Vermilion County has been the pioneer and its actions have been closely watched by the entire State. The success in overcoming all obstacles will be a great moral aid to the other communities and this favorable decision of the court has established precedents which should clear the path of practically every legal snag, for all the counties.

The sale of the bonds, which bear four per cent. interest, took place on January 20th.

The map shows the general plan for carrying on the work. The system comprises a total of 173.2 miles, divided into nine divisions of approximately equal length. These divisions are arranged with reference to minimum haul of materials from railroad sidings.

Apparent gaps in the system, notably around Danville, obtain where there already are improved roads, mostly of brick built under State aid during the past two years. When completed the bond issue roads will be taken over by the State as a part of the State aid road system. This action is possible by virtue of a law passed at the last session of the legislature which in effect provides that counties may anticipate State aid and improve their system of State aid roads all at once by means of a bond issue. Then, as the State aid funds become due, they can be used to pay the interest on and retire the bonds.

Plans and specifications for the roads have been approved by the State Highway Commission. The types will be concrete and brick, ten feet wide, with three-foot shoulders of macadam or gravel. None of the funds will be used for bridge work.

*(Continued on page 62)*

# Some New Departures in Asphaltic Concrete Construction Tried Out in Oak Park, Illinois

By Lester Kirschbraun, Ch.E., Consulting and Testing Engineer, Chicago

THE very active development of the western suburbs of Chicago with its incidental automobile traffic, has stimulated the growth of portions of the village of Oak Park, rendering necessary the construction of a very considerable yardage of paving during the past five years. Especially within the last three years, certain sections have developed and built up with such rapidity that the paving construction recently has been particularly heavy.

As the community is almost entirely of a residential character, with a few main arteries or streets carrying traffic teams, a special type of asphalt construction was sought for which would combine to the greatest extent the permanency of a mixed wearing surface with low cost and reasonable durability.

A very considerable portion of the streets of the village were originally paved with waterbound macadam. These pavements had served for many years in the developed portions of the town and it was desired to select a type of construction suitable to be laid both over the old macadam and on a concrete base where the construction was entirely new. The largest yardage has been laid over concrete.

Initially, the Topeka mixture was used, but this did not appear to meet the ideas of the officials in charge, and a special mixture was therefore devised to cover these ideas of low cost, permanency and economy.



**Fig. 1. Spreading Asphaltic Concrete**

Experiments in the laboratory with various aggregates led to the formulation of a mixture containing a larger percentage of coarse aggregate than the Topeka mixture, without increase in size of such aggregate, the idea being to develop a miniature asphaltic concrete or rather a grit mixture in which the comparatively large amount of small grit, generally smaller than quarter-inch, would be filled with a mortar of standard sheet asphalt mixture. In this way a true concrete was developed which has been extensively used in several hundred thousand square yards of construction, and which appears to give good service in use under the light conditions of traffic pertaining to the locality.

In actual construction, crushed limestone was used as grit, the total mixture carrying about 40 to 50 per cent. of grit, about 10 per cent. of filler, and 6 to 6½ per cent. of bitumen, the remainder being sheet asphalt sand. For pavements carrying anything but light traffic, a harder grit—granite or crushed gravel—has been recommended.

The first pavement laid with this mixture was upon Grove Avenue in 1913. The surface was covered with a squeegee coat to fill the superficial interstices of the mixture, this squeegee coat carrying in turn, a thin scattering of granite chips which were ground up in the usual manner by traffic, leaving a comparatively smooth surface in the course of time.

In the same year the most important construction was upon Washington Boulevard, comprising some 40,000 square yards, extending from Austin to Harlem Avenues. This boulevard carries a very heavy automobile traffic, being practically the only through artery from Chicago.

In laying this pavement on Washington Boulevard, attention was directed towards preparing a mixture which would be sufficiently stiff to resist the rutting effect of automobile traffic which had become so evident upon the boulevards and heavily travelled automobile streets of Chicago and vicinity. So far this pavement has successfully withstood such heavy traffic of as high as 10,000 automobiles upon a Sunday.

It was noted in laying the earlier streets, that this mixture appeared to be rather difficult to handle on the street in the way of obtaining a smooth surface. After having been squeegeed, the surface while, appearing to be reasonably smooth, would soon become choppy after the squeegee had worn in. At this time the contractors handling the work had not been accustomed to placing squeegee and the general tendency in applying it was to leave thick or thin places of asphalt cement, and the mineral particles spread rather unevenly upon this asphaltic cement. It seemed impractical, even with the best attention, to break in men who could be depended upon to handle the squeegee in such a way as to ensure its uniform application. It was thought that this factor accounted to a considerable extent for the lack of the desired surface, and, in 1914, the squeegee coat was omitted from the specifications and Portland cement substituted for the purpose of securing the final finish.



**Fig. 2. Giving the Asphaltic Concrete its first rolling. A ten-ton tandem roller is being used.**

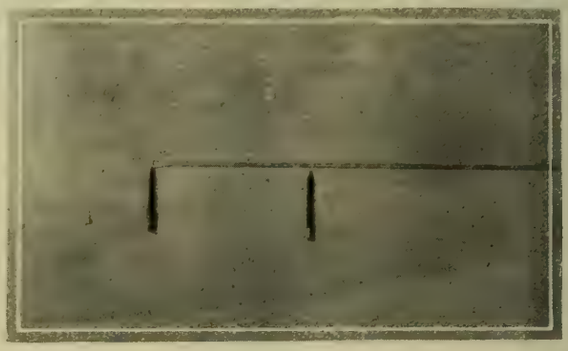


**Fig. 3. View looking straight down on newly laid pavement. Cement has been brushed on and the surface received its final rolling. The pencils are twelve inches apart.**

The first pavement laid without squeegee was constructed on Forest Avenue between Lake and Chicago Avenues. Incidentally this construction was of much interest as it replaced a badly worn sheet asphalt job, about twelve years old, which had deteriorated to such extent as to require replacement.

It was the idea of Mr. W. F. Sargent, Commissioner of Public Works of Oak Park, that the street might be advantageously surfaced without the removal of the old asphalt, thereby lessening the cost and adding to the thickness and value of

*(Continued on page 60)*

Prepared for "Better Roads and Streets" and also presented before the Illinois Society of Engineers and Surveyors, Urbana, Ill., January 22, 1916.

# Snow Fighting in Our Largest City

AS recently as ten years ago, little attempt was made, even in the largest of our cities, to systematically combat the snow storms. Excepting in a very limited area, and in most cases throughout the entire city, little attention was given to the problem of removing and disposing of this enemy to traffic. But this condition has entirely changed in the past five years, and exceptionally rapid strides have been made in the last two years. Throughout practically the entire business sections of our leading cities, the snow is removed as rapidly as possible after it has fallen, and in several of the largest cities, notably New York City, Chicago, and Philadelphia, the work of removal is started within a couple of hours after the storm has started. This is what has been officially termed "Snow Fighting" and during the past two winters has proven so successful and economical that this winter a large number of smaller cities decided to take up this method of combatting the snow storm.

In snow fighting, New York and Philadelphia have undoubtedly made the greatest progress, and both cities have worked out systems that mean a tremendous saving in money to the municipalities. The systems in these cities are almost identical, differing principally as regards topographical and underground conditions, the latter reference being to the sewers, which have come to be recognized as one of the most important means of final disposal.

In the cities mentioned above, the snow fighting system has been entirely successful so far as the system is concerned, but in both cities there was some considerable trouble in securing labor, in spite of the high wages that are paid for this kind of work. In neither New York City or in Philadelphia are there the usual number of unemployed men this winter, owing to the hundreds of millions of "war orders" for munitions that are being manufactured. The scarcity of labor has handicapped the mills and manufacturing plants for the past six months, and this has caused a scarcity in men available for snow fighting. Also, just as was found out in New York this winter, there are many thousands of men physically fit who are out of work, but who do not want to work.

This article will deal entirely with the methods employed in New York City and the system that has been worked out by John T. Fetherston, Commissioner of the Department of Street Cleaning of that city. His rules and instructions are so complete and explicit that they will be of interest and value to the street officials of every city in the country. As this information has never before been published, the complete workings of his department in snow fighting as completed last November are given as they were explained by Commissioner Fetherston to the writer. Other cities can modify these methods and rules to suit their particular conditions and funds, so they will be of general interest.

It is planned during the present winter to shove snow into the sewers as it falls, and as fast as it falls, from the roadways of streets as follows:

1. From scheduled streets other than mandatory contract streets.

2. From intersections, cross-walks, and near-side car-stops of non-scheduled streets, the car-stop area to be approximately forty feet long, measured back from the cross-walk along the rail and approximately ten feet wide.

It is planned to pile snow from cross-walks and roadways of mandatory contract streets; also near-side car-stop areas of streets assigned for clearing to street railway companies and left for the contractor or railroad to remove.

Plans call for the clearing of roadway areas only. It is assumed that snow falling on sidewalks will be placed by the property owners in the gutters while the snow is falling, or shortly after the storm is over, and then shoved by emergency laborers into manholes.

While a storm is in progress during the day or night, sweepers and officials may obtain the co-operation of householders by requesting that they clear the sidewalks promptly, and by informing them that if the sidewalks are not cleared by the time the roadway is finally cleared, the snow must be piled and left on the sidewalk at the edge of the curb.

### THE SNOW FIGHTING FORCE.

The snow fighting force will consist of the officers and men of the department, and of emergency laborers temporarily employed for snow fighting work, and pay clerks drafted from other city departments.

In charge of the entire force will be the Commissioner, assisted by Deputy Commissioner Kalbach. They will alternate in tours of duty during a continuing storm.

The work in each borough will be conducted under the direction of the Borough Deputy Commissioner, who will make bi-hourly reports by telephone to the main office on the progress and state of the work. He will notify the main office at once of occurrences interfering with the progress of the work.

Other officers and men of the department will work with duties which will be specified later under titles, and in order of rank as follows:

Borough Superintendent.
District Superintendent.
Section Foreman.
Pat Clerk.
Division Foreman.
Squad Leader.

### AREA ASSIGNMENTS.

Area assignments are made so that each squad will be able to go over the area twice in each shift with the heaviest rate of snow-fall. With lighter storms, the rate of work should be faster.

### CHECKING THE RATE OF WORK.

Each squad leader, division foreman, section foreman, and district superintendent will be held accountable for a proper report on the work performed. With the squad leader, this is a matter of direct continuous contact with the work. With the officers, checking the work of each shift during a continuing storm will be a matter of inspection. The depth of snow covering the different parts of the snow routes will indicate the work performed and the rate of work.

A final check on the rate will be obtained upon the conclusion of the work. If the force disposes of the snow as fast as it falls, each route will be cleared in the number of hours equal to that during which the snow fell, so that if the force starts on the work, for example, four hours after the storm started, the work should be completed four hours after the storm stops. Incorrect reports of the rate of work will be made the subject of charges.

### COMPENSATION.

Two rates are established for both regular and temporary employees. If the task set is accomplished within the time limit, sweepers and assistant squad leaders will be paid at the rate of fifty cents per hour. Assistant section foremen, section foremen and district superintendents will be allowed fifty per cent. in addition to their regular rates of pay for time actually employed in the work.

For work accomplished short of the time set for the task, sweepers and assistant squad leaders will be paid at the rate of thirty-five cents per hour. Assistant section foremen, section foremen and district superintendents will be allowed their regular rates of pay for time actually employed on the work.

Emergency laborers will be paid at the rate of $3.20, which is the bonus rate, and $2.40, which is the regular rate, per shift of eight working hours, according as to whether the task set is accomplished or not.

Officers in the Department are instructed to be vigilant in detecting loafers, as such men affect directly the rate at which the Department of Street Cleaning employees are paid. For example, in order that the sweeper (squad leader) may be entitled to the higher rate of pay, it will be necessary that the eight or ten men, or whatever number of men are assigned to him, go over and clear the snow route area at least twice in an eight-working-hour shift. In order that the division fore-

man and section foreman may be entitled to the higher rate of pay, it will be necessary that all the squads over which they exercise supervision shall have accomplished the task set—that is, to have gone over each snow route at least twice in each eight-hour working shift. In order that the district superintendent may be entitled to the higher rate of pay, it will be necessary that the task set for each section has been accomplished—that is, that every snow route in each section shall have been gone over and cleared at least twice in each shift. Where the panning of snow into the sewers is stopped for any good reason, piling at the manholes will be assumed to be equivalent to shoving the snow into the sewers. Piling should not be resorted to unless absolutely necessary. Where one man can feed the snow faster than the sewer will take it, all the snow that the sewer will carry away should be shoved into it, and the remainder should be piled.

HOURS OF WORK.

The officers, sweepers (squad leaders) and emergency laborers will work in two shifts, with one hour for luncheon included, and when official starting orders go out, day or night, all officers and sweepers will report to their stations at once. Those assigned to Shift No. 2 will remain on duty until Shift No. 1 has been working one hour. They will then go home, to report later for Shift No. 2 in accordance with the time table arranged.

PAYMENTS.

Payments to Department of Street Cleaning Employees will be made in accordance with the regular pay schedule. Payments to emergency laborers are made at section headquarters on the day after that on which the snow stops falling. The time of paying the different shifts has been arranged as follows, so that congestion is avoided.

At 5:00 P. M. to men working in the first section of each district.

At 5:45 o'clock to men working in the second section.

At 6:30 o'clock to men working in the third section.

At 7:15 o'clock to men working in the fourth section.

At 8:00 o'clock to men working in the fifth section.

At 8:45 o'clock to men working in the sixth section.

The section foremen and the pay clerk are instructed to be present at section headquarters, and preserve order among the emergency laborers. The foremen line the men up in the order of their ticket numbers. The men are instructed to have their pay tickets ready to hand to the paymaster. The pay clerks collect all badges at the end of each shift.

Following are the rules and regulations which have been worked out by Commissioner Fetherston, governing the panning or shoveling of snow into the sewer manholes. It will be noted that the "Safety First" idea has been taken into consideration throughout, and rightly so, as carelessness in leaving manholes open would be a serious menace to traffic using the streets, and numberless accidents would be certain to occur.

RULES AND REGULATIONS FOR PANNING SNOW INTO THE SEWER MANHOLES.

1.—No manhole shall be open except when being used for the disposal of snow. Before depositing any snow in a manhole, the sweeper must see that the sewage is flowing free from obstruction.

2.—A note will be made of the approximate depth of flow in the sewer before the depositing of snow is commenced.

3.—Hose streams may be used to increase the flow in the sewers, and at as many points as may be served by the quantity of hose in the Department. Additional hose may be borrowed from the fire houses.

4.—Careful watch shall be kept on the sewer, so that it will not choke from too rapid panning of snow, which should be shoved into the sewers at a uniform and continuous rate. Should the flow of the sewer fail to carry the snow away freely, panning at the manhole shall be discontinued until the manhole has been cleared and the flow of the sewer restored.

5.—Whenever the flow of the sewer or the water from the hose streams, or both, do not freely carry away the snow after the panning has been discontinued, the District Superintendent of Sewers shall be immediately notified through District Headquarters, and the snow piled near the manhole.

6.—All snow deposited in the sewer manholes shall be free from sticks, ice, stones, cans, ashes, garbage, or other materials which would injure or obstruct the sewer in any way.

7.—Should a squad be working over a trunk sewer where the whole squad may be employed to clear the area about the manhole, one man shall constantly guard the open manhole.

8.—All directions given by the District Superintendent of Sewers shall be implicitly followed.

9.—No corporation, private individual, contractor nor any city department shall be permitted to dump snow in any manhole unless permission has been granted by the Commissioner of Street Cleaning and approved by the Engineer in charge of sewers.

10.—The city contractors or other corporations or individuals who have permits for dumping snow in the sewers shall not be interfered with.

The duties of the various officials who are working on snow removal work are explicitly defined by Commissioner Fetherston in a set of definitions prepared by him, and setting forth what is required of such officials. These definitions are as follows:—

*Borough Superintendent.* The Borough Superintendent will assist the Deputy Commissioner, and will alternate in tours of duty with him when a snow storm is of long duration.

*District Superintendent.* The District Superintendent will be in charge of the snow fighting work of his regular district. He will, when snow falls by day, or when called at night, go to district headquarters and report by telephone to the borough office.

He will then visit the section stations and observe that assignments and the starting of squads to the various routes are carried out in an orderly and proper manner.

He will, during his tour of duty, inspect the work and give such directions as necessary, and will correct all improper methods of work.

If the section foreman is not present, he will dismiss any emergency laborers who are loafing on the job, taking up these laborers' tickets and badges, and marking "dismissed" and the time of dismissal on the back of each section of the ticket. He will retain the original and duplicate, if the ticket is in triplicate, returning the triplicate to the laborer. If the ticket is in duplicate, he will retain the original and return the duplicate to the laborer. He will then have the sweeper take charge of the panscraper. He will tell the discharged laborer to come to the proper place for his money on pay day and will deliver to the pay clerk all tickets that he has taken from such discharged employees.

He will make telephone reports as follows:—

1.—When his district is fully manned, both at the beginning of the storm and after the nine hour shift.

2.—The state of the work every even hour of his tour of duty.

3.—Immediately, by using the nearest telephone, if there is any stoppage of the sewers, inability to obtain sufficient flow in the sewers, any shortage of laborers to cope with the storm in his district, or any occurrence which interferes with the progress of the work.

4.—As soon as possible the number of laborers who apply for work in excess of the number actually required.

The District Superintendent will observe, during his tours of inspection, the rate of work of all the squads, and note the area that has been gone over, as well as the area that remains to be gone over, so that he may be able to estimate with a fair degree of accuracy whether the squads are working at a rate required to finish the task within the time limit. When the storm is of long duration, he should base his certificate on the pay roll on the section reports, supplemented by his personal observations made during his last tour of inspection on the streets of his district.

He will require his clerk to make a snow fighting pay roll for himself and the other Department of Street Cleaning officers in his district, certifying to the rate of pay; also for pay clerks at section headquarters, and other city employees.

In making tours of the streets, he will be accompanied by the District Superintendent of Sewers, with whom he will co-operate, and who, in turn, will render all possible assistance. All telephone reports of trouble will be immediately referred to the District Superintendent of Sewers.

If traffic conditions are so severe as to seriously affect work, he is instructed to call up the Traffic Inspector through Police Headquarters, and make a request that traffic be di-

verted temporarily. He should then notify the Traffic Inspector when conditions have become normal and traffic can be resumed. If a traffic policeman is nearby, he should be asked to divert traffic, which he has the authority to do.

*Section Foreman.* The Section Foreman will be in charge of all work in his section. He will, when snow begins to fall by day, get and keep in close touch with his district headquarters for orders, or, when called at night, in case of a snow storm, go to his section station to take charge of the assignment of emergency laborers to the sweepers for work on snow routes, in accordance with the map that has been prepared, and with the general assignments and schedule which all section foremen have been provided with.

He will assist the pay clerk in making preparations for the distribution of badges and tickets. It is also his duty to preserve order among those arriving for work. He will go out in his section and personally direct the work. He is instructed to dismiss any and all laborers who are found loafing on the job, taking up such offender's tickets and badges, marking "dismissed' and the time of dismissal on the back of each section of the tickets. He retains the original and duplicate if the ticket is in triplicate, giving the triplicate to the dismissed laborer. If the ticket is in duplicate, he retains the original and gives the laborer the duplicate, telling him when and where to come for his pay. He then has the sweeper take charge of the pan scraper, and will deliver to the pay clerk all tickets of dismissed employees.

He will observe the rate of work of the squads and note the length of street that has been gone over, as well as the length of street that remains to be gone over, so that he may be able to estimate with a fair degree of accuracy whether the squad is working at the rate required to finish its task within the time limit. Comparison will be found to be the most efficient means of forming a fair estimate. He will aid the squad leaders in any difficulty that is reported to him.

He will report immediately from the nearest telephone to district headquarters any stoppage of sewers or sewer manhole, inability to obtain sufficient flow in the sewers, any shortage of laborers to fill routes or anything which interfered with the work.

It is his duty to return to the section station about thirty minutes before it is time for his shift to return. He will inform his relief of the state of work at the end of his shift, and of any new or special orders that were received while he was on duty. He will require the sweeper to state that the men were at work during the whole shift, and whether or not the route was cleared twice. He will require all of his division foremen to make similar statements, and will instruct his men to turn over their tickets to the pay clerk, telling them to return ready for work at the end of nine hours. He will furnish the pay clerk in writing with the time the squads stopped work on the street, and also the rates of wages to be paid to his squad leaders and laborers.

The section foreman for the next shift will come on duty one hour before his men are sent to work, as will be shown on the time schedule, and he will follow the procedure herein described for the first shift. Should the number of men applying for work with the second shift be in excess of the requirements, he will instruct them to go to the district headquarters, where they may be assigned to another section, or sent to another district.

Upon completion of his first tour of duty, he will inform his relief of conditions in the section, and will return for work to the section station at the hour indicated on his schedule.

*Division Foreman.* The division foreman will assist the section foreman, and will be in charge of that portion of the section that is assigned to him.

He will, when snow begins to fall by day, go to the section station to which he is assigned, or when he is called out at night will go to his section station to aid in the assignment of emergency laborers to the sweepers in charge of squads.

He is particularly charged with the issue of all tools at the section station, and in this work will be assisted by the section station keeper. When the men have all been assigned, he will go to his division and will perform duties as are described for the section foreman in the field.

*Squad Leaders.* The squad leader will be a sweeper whose street cleaning route will generally be included in the snow route. If regular or extra sweepers are not available as squad leaders, he will use an emergency laborer and assign his squad to piling work if possible. Such a man will be known as an assistant squad leader.

He will, when snow begins to fall by day, or when called out at night, go immediately to the nearest section station. The squad leader will be in charge of the emergency laborers assigned to the squad, and he will take them to the snow route and start work at a point previously determined by the section foreman. He will be held responsible for all equipment that is furnished to his squad.

Two methods of work will be employed in clearing the streets of snow. The snow will be panned into large sewers having a fair flow of sewage, using a gang at one manhole. Where this gang method is employed, a man will be stationed at the manhole to guard it, and to shovel into the manhole any snow that is left outside by the pan scrapers.

The gang method will also be employed on heavy traffic streets without reference to the size of the sewer. If the sewer is small, the snow will be piled around the manhole and a man stationed there to guard it. This man will be left at the manhole until he has shoveled the snow pile into the sewer.

In starting work on other routes than on heavy traffic streets, served by a small sewer in which the flow is not sufficient to carry away the snow, the sweeper will use the hose if same is supplied.

In demonstrating to the emergency laborers the method to be pursued, he will perform operations in the order described as follows:—

1.—He will locate the manhole and the two adjoining manholes.

2.—He will pace the distance between the manholes and locate the line which equally divide the areas on each side of the manhole.

3.—He will start a stroke in one gutter from the dividing line, shoving the pan scraper such distance as will gather a full sized load.

4.—He will raise the pan scraper so as to upset the load, leaving a small pile in the gutter.

5.—He will proceed and repeat this operation and continue getting scraper loads until he arrives at a point opposite the manhole.

6.—He will then make a stroke towards the manhole, using snow thus gathered to form one of the piles, leaving a clear space of about three feet on the down-stream side for the manhole cover.

7.—He will return for each of the scraper-load piles, bringing them to the pile started.

8.—He will continue making the four gutter strokes necessary to this area to form the two protecting piles on each side of this manhole and in line with the length of the street; that is, the two piles and the manhole will be in a line with the line of the curb.

9.—He will pack down the top of each pile and will stick a red flag in each.

10.—He will take his pick, open the sewer manhole, placing the cover in line with the sewer and on that side which is in the direction of the flow.

Should a small pipe sewer have sufficient flow, he will proceed as described.

For further instruction, he will gather on the pan scraper a full-sized load of snow and will shove it into the manhole. He will then station a man to clear the area adjacent to the manhole. He will take his squad to the next manhole, pace off for division of areas, assign and direct an emergency laborer to proceed making gutter-strokes and form piles at the manhole. He will then go on stationing laborers in like manner until all the members of his squad are stationed, leaving two red flags with each laborer.

He will go back with his pick and open manholes in each area in which protecting piles have been formed.

He will go back and forth over his route as often as possible, observing the manner in which his men work. Should any of the men loaf on the job, he will make a report to the division foreman or the section foreman when either appears on a tour of inspection. When all goes well, the sweeper will help those men whose assignment seems to be more difficult than others by himself panning snow from that laborer's area.

He is particularly charged with the observation of the sewers to prevent the clogging of manholes and to prevent litter being thrown into the manholes with the snow. Emergency laborers must be instructed to pick out foreign material before shoving the scrapper load of snow into the sewer.

In streets where litter is known to be present, the first covering of snow will be panned into two piles as described for each manhole in use, except that piles at such points will be much larger.

The clogging of the sewers with litter is inexcusable, and charges will be preferred against sweepers in charge of routes in which such clogging occurs.

Should a sewer manhole become clogged, the squad leader will at once devote his energies toward clearing it. While he is thus engaged, the man clearing the adjacent area will collect the snow, and will add it to the piles at the manhole. He will then report such clogging to the division foreman, section foreman or the district superintendent when they arrive on one of their inspection tours.

When the area on which the squad is first placed has been gone over and cleared, the squad leader will take his squad to the next area on his route, proceeding in the same manner as described for the first area gone over, except that it will not be necessary to repeat the instructions given at the first manhole. After going over the whole route, the squad will return to the starting point and go over and clear the route again, and as often as possible, but not less than twice in a nine-hour shift.

Before leaving an area that has been gone over and cleared, the snow in piles at the manholes will be shoved into the sewers if the snow is clean. If it contains foreign material, it will be left in the street to be carted away by the department vehicles. The squad leader will assure himself that all manhole covers have been properly replaced before going from one location to another.

At the end of the nine-hour shift, the squad leader will wait for his relief on his route, and will turn over to the squad leader of the succeeding shift all articles of equipment before going to section headquarters, unless he is otherwise ordered. He will be required to make a verbal report as to the number of times the area assignment has been gone over and cleared.

He will, when requested by the finance inspector and the time checker, show his time card on which are entered the badge numbers of all the laborers in his gang. When his gang has been checked in, he may leave the section station to return at the end of nine hours for the resumption of the work on his route. He will report for work even though the storm has stopped during his period off duty.

*Pay Clerk.* Special detailed instructions have been issued for the pay clerks, and covering the duties in detail at great length. Additional instructions are as follows:—

When the second shift has been turned out, he will advise men in numbers reporting in excess of requirements to go to district headquarters, where opportunity may be had for assignment in another section.

With snow falling for a longer period than eighteen hours, the first shift will come back for work, becoming the third shift, and with storms lasting longer than twenty-seven hours, the second shift will come back, becoming the fourth shift, etc. Laborers' badges are in two colors, namely, white and pink. White badges will be used for shift one, and pink badges for shift two.

### PROCEDURE AT SECTION STATIONS.

Reporting at the section stations will be in the following:—
Section Foreman.
Pay Clerk.
Division Foreman.
Sweepers.
Emergency Laborers.

The emergency laborers are lined up outside the section station in the order of arrival, unless a room is available in which they may be lined up. Two lines will be formed, one of the men who have "identification" cards, and the other of those who have not enrolled and who are applying for work for the first time. The sweeper of the squad will be brought into the room in which assignments are made, and a few men having "identification" cards will be brought in.

The section foreman will then announce the number of the squad to which the laborer is assigned, and will also note upon the sweeper's squad card the badge number of the emergency laborers assigned to him. The emergency laborer will then join the sweeper.

This procedure will be followed until the first squad is filled. The sweeper or squad leader will then take the squad to the division foreman, who will issue tools as follows:—

Emergency laborer—1 pan scraper.

Sweeper, or squad leader—1 pan scraper, 1 pick, 2 red flags for each laborer in his squad, 1 shovel and 1 bleeding pole.

The other squads will be filled in the order of the importance of route, with the same procedure as for the first squad.

When all the squads have been filled, the excess applicants will be told to come back in nine hours for work on the second shift.

Men who have no identification cards and who apply for work will not be assigned until all the men who have identification cards are assigned. Identification cards will be made out and will then be handled in the same manner as those made out as the result of registration.

Upon the expiration of nine hours, the second shift is lined up by squads with badges and tickets issued, and proceed at once to relieve the first shift waiting on their routes. Tools will be transferred from the first squad to the second squad, and laborers of the first squad will return at once to section headquarters.

By squads, men will then give tickes to pay clerks, who in turn will return to the laborer his section of the ticket. The section foreman will then instruct all men to return for duty at the expiration of nine hours.

The section foreman will complete his report and certify to the pay-roll before leaving the section station. He will return hour before the schedule time of the return of his shift.

### GENERAL RULES OF PROCEDURE.

There are some general rules of procedure which have not been included in the duties and procedure of the various employees as already given in this article.

At the beginning of work, all department employees assigned to snow fighting will go to work at the time indicated for the first shift at the hour given in the time schedule with which they are provided.

Until the division of the force is made, those officers assigned as section foremen, division foremen and squad leaders for the first shift will be in charge, and will be assisted by those holding the same titles for the second shift. The tour of duty for day and night work for district superintendents will be from six A. M. to six P. M., and from six P. M. to six A. M. respectively.

When the change of shifts is made, the instructions will be interpreted to apply in the same manner to those assigned to the second shift as they do to those assigned to the first shift.

Extra sweepers may be used as squad leaders in sections where there is a shortage of regular sweepers to take charge of snow routes. Where the snow routes are in charge of a regular sweeper, extra sweepers will be employed as emergency laborers. Extra sweepers will be paid on the emergency laborers' pay roll, and they will wear their Department uniform.

Regular sweepers in excess of the number required as squad leaders will be used in the place of laborers on the more important routes, but their time shall be recorded on the regular squad leaders' pay roll.

Men who lose tools will be required to pay for them before they receive their pay. The rates for lost equipment are as follows:—

| | | |
|---|---|---|
| Asphalt scrapers | $1.20 | each |
| Picks without handles | .40 | each |
| Pick handles | .128 | each |
| Scoop shovels | .535 | each |
| Bleeding poles | 2.00 | each |
| Hydrant Pumps | 6.37 | each |
| Hydrant keys | .097 | each |
| Flags | .03 | each |

It was found necessary to make these charges against the men on account of the large number of tools that were lost or stolen. It has, therefore, tended to make the men more care-

*(Continued on page 61)*

# Report of the Sub-Committee on Bituminous Concrete Paving Specifications

SINCE the annual meeting of the American Society of Municipal Improvements held at Dayton, Ohio, the middle of October, there have been a large number of requests for the publication of the specifications as drawn up by the above committee, over which it will be remembered there was so much controversy. The writer has also talked with a large number of interested parties in the East, and there seems to be a very general haziness as to the exact contents of these specifications. We are, therefore, presenting these specifications in detail, without additions, corrections, or any other changes other than the revised proportions of the various ingredients, these having been stated at the Dayton meeting.

The specifications are interesting, and will be of more than ordinary interest to city engineers, county road officials, and material manufacturers and dealers alike. At the conclusion of these unabridged specifications will be found the report and comments of the sub-committee.

## SPECIFICATIONS FOR BITUMINOUS CONCRETE PAVEMENT

*Subgrade.* The contractor will be required to do all of the grading necessary to bring the surface to the proper subgrade as determined by the lines and grades given by the engineer. If the material at subgrade is of an unstable character, and unfit for foundation, the contractor shall make such additional excavation as may be determined by the engineer, and refilled with approved material. After all necessary grading has been done to bring this surface to subgrade, the street shall be thoroughly rolled with an approved road roller weighing not less than ten tons. If settlement occurs, the depressions shall be filled and then rerolled until the surface is solid, uniform, and parallel with the grade and cross-section of the finished pavement. All filling shall be free from animal or vegetable matter, and of a character approved by the engineer. In cases of spongy or yielding subgrade, some other means besides ordinary rolling and sprinkling must be employed to obtain satisfactory compaction of the subgrade. In the case of loose, sandy soils, a small amount of cinders, gravel, or fine crushed stone spread over the surface will often put it in a condition to be compacted under the roller. In the case of clay soils that puddle up and wave or creep under continued rolling, it is best to roll as dry as possible, and to be sparing in the use of water when rolling the first layer of macadam. Cinders, gravel, or stone screenings will often help in rolling such subgrades.

*Sub-Drainage.* When the soil is of such a character that it retains an excessive amount of moisture, such as clay subject to swelling or heaving under action of frost, or sands similar to quicksand that do not afford a ready natural drainage, subdrains should be provided.

These may be of two general kinds. First, tile drains of open porous material or vitrified tile with open joints. Second, trenches filled with broken stone, gravel, cinders, or other similar material.

In some cases, it may be sufficient to construct a subdrain on each side of the roadway at or near the lines of the gutters, but when the soil is of a very wet nature, it may be advisable to lay additional lines of drains which may be in or near the middle of the roadway. This system of drains may be varied by diagonal lines of drains running from near the crown of the roadway to the gutters.

In all cases, the drains should have connections with the existing sewers, catch basins, or inlets.

*New Macadam Foundation.* If the pavement is to be laid on a new macadam foundation or base, the latter shall be built as follows:

The total thickness of the macadam base will vary according to the character of soil, drainage, kind of stone available, etc. In general, the macadam base should be constructed of broken stone which is sound, hard, and durable under traffic. The broken stone should be separated into different sizes by screening, the smaller sizes with the dust being used to fill and bond together the larger sizes. The thickness of the base should be regulated by experience in constructing ordinary waterbound macadam roads in similar situations, the total thickness of pavement, including wearing surface, being made the same or a little less than well-constructed macadam.

After the subgrade has been carefully prepared, spread a layer of clean stone passing a three (3) to three and one-half (3½) inch revolving screen and held on a two (2) inch screen to a depth sufficient when thoroughly rolled to form about two-thirds of the total thickness of the base. The thickness of this layer should be regulated by laying on the subgrade at proper intervals, cubical blocks of wood of the proper dimensions to give the desired thickness. Over this layer of stone, spread with shovels stone screenings in sufficient quantity to fill the voids between the larger stone. The screenings should be spread gradually and thoroughly rolled with a good roller weighing at least ten tons.

*Old Macadam Foundation.* If the pavement is to be laid on an old macadam foundation, the surface shall be thoroughly swept and cleaned of all fine material that may be caked upon the surface of the stone, or lying loose as dust, thereby exposing the clean, coarse stone for the reception of the bituminous concrete.

If the old macadam does not present the desired coarse, grainy surface, or is not at proper and satisfactory grade after cleaning, it is spiked up and redressed to the desired crown and grade, the coarse stone being brought to the top by harrowing or otherwise, or new stone added where needed. It shall then be watered and rolled until thoroughly compacted. If the result is not the required coarse, grainy surface, a layer of clean stone shall be spread and lightly rolled as described above in the paragraph relating to new macadam foundation.

*Concrete Foundation.* When a Portland cement concrete foundation is used, it should be laid according to the standard specifications adopted for concrete foundation. The surface, however, should be roughened to form a key for the wearing surface. This may be done by using coarse stone of fairly uniform size and laying the concrete fairly wet, or by brooming, washing with a hose before hard set, tamping with grooved rammers, or by spreading a light layer of coarse, clean stone over the fresh concrete and lightly tamping.

*Curb.* If a curb or curb and gutter is used, the face against which the paving material will be laid shall be painted with a coat of hot bituminous cement in advance of the pavement.

A curb or a curb and gutter should be used in all cases of a street devoted to miscellaneous uses, and where there is occasion for many vehicles to stop at the curb line, but in the case of a park driveway or a suburban highway, a bituminous concrete pavement may be successfully used without a curb. No other protection for the edge of the pavement is required except to provide a coarse, grainy base into which the paving material is rolled.

*Wearing Surface.* On the foundation, as heretofore specified, shall be laid the bituminous concrete wearing surface, which shall consist of a mineral aggregate mixed with bituminous cement, and laid as hereinafter specified.

This wearing surface shall have a thickness of .... inches after thorough compression with a roller.

For heavy traffic, a thickness of two (2) inches is sufficient for all practical purposes, and in some cases will afford more stability than a greater thickness.

For moderate and light traffic, one and one-half (1½) inches will be sufficient thickness for the wearing surface when laid on a well-constructed base as specified above.

*Mineral Aggregate.* The mineral aggregate shall consist of a mixture of broken stone and sand, to which shall be added as required stone, dust, or Portland cement.

Any sound, durable stone, either trap rock, limestone, or granite, usually considered suitable for macadam, may be used. It should be broken as nearly cubical as practicable. It should not show distinct planes of cleavage or crystalline faces, and

should not readily crush or split under the roller when being rolled in the pavement. Between two kinds of stone, choice should generally be made of the one showing the greater toughness rather than hardness. A certain percentage of absorption, such as is shown by the better grades of limestone, is a desirable quality, as the bonding strength of the cement is somewhat improved thereby.

The sand shall be hard grained, moderately sharp, free from loam or other foreign matter, and varying in size from that passing a one-quarter (¼) inch screen to dust passing a two hundred (200) mesh screen. There shall not be over five (5) per cent, by weight passing the two hundred (200) mesh screen, and there should not be over twenty (20) per cent. held on the ten (10) mesh screen.

Dust in the form of finely ground limestone or Portland cement may be added to the mixture, but in such quantities that the screenings of the total ingredients entering into the mix shall in no case show over eleven (11) per cent. by weight, passing a two hundred (200) mesh screen.

The proportions of the various ingredients composing the bituminous concrete shall be as follows:

Passing a 200 mesh screen, 7 to 10 per cent.
Passing an 80 mesh screen, 10 to 20 per cent.
Passing a 40 mesh screen, 10 to 25 per cent.
Passing a 20 mesh screen, 10 to 25 per cent.

Passing an eight mesh screen but retained on a one-half inch screen, 30 to 50 per cent. This material may be straight crusher run rock, but the samples for examination should run approximately as follows:

Passing 8 mesh screen, 10 to 20 per cent.
Passing 4 mesh screen, 15 to 20 per cent.
Passing 2 mesh screen, 5 to 10 per cent.

The minimum amount of bitumen allowed shall only be used in mixtures containing the minimum total passing the 80 mesh screen. The percentage of bitumen must be increased above minimum as total passing the 80 mesh screen increases.

The item designated as dust includes in addition to the Portland cement or stone dust that may be added, fine sand passing a 200 mesh screen not exceeding five per cent. of the total mixture and such 200 mesh mineral dust contained in the refined asphalt.

*Method of Mixing.* The aggregate shall be dried and heated in properly designated driers before mixing with the bituminous cement. The driers shall be of the revolving type, thoroughly agitating and turning the materials during the process of drying. When the aggregate is thoroughly dried and heated to a temperature of from 200 to 350 degrees Fahrenheit, depending upon the bituminous cement used, it shall be immediately, before cooling or exposure to moisture, mixed with the hot bituminous cement as hereinafter specified. If stone dust is used, it shall be introduced directly into the mixer without passing through the drier.

The bituminous cement shall be melted in a tank arranged so the heat can be properly and easily controlled and regulated. When melted and raised to a temperature of from 200 to 350 degrees Fahrenheit, depending on the bituminous cement used, it shall be combined in the proper proportions with the hot aggregate and immediately mixed in a properly designated mixer with revolving blades until a thorough and intimate mixture of the ingredients has been accomplished, and the particles composing the aggregate evenly and thoroughly coated with the bituminous cement. The mixer shall not be exposed directly to the action of fire.

*Method of Laying.* While still hot from the mixer, the paving mixture shall be spread evenly on the foundation with hot iron rakes and shovels, so that when compressed with the roller it shall have the thickness specified, with the surface even and true to grade. Along the curbs and around manholes, catch basins, and other obstructions in the street, where the roller cannot reach, the compression shall be secured by the use of hot iron tampers. The rolling and tamping shall be done as quickly as possible after the material is spread and while still hot and pliable. When the paving mixture is hauled on the street in dump wagons, it shall be, when ordered by the engineer, kept covered with canvas to retain heat, dumped on platforms and shoveled into place and raked to the proper grade. As soon as spread, the paving mixture shall be rolled with a tandem roller weighing at least six tons, and the rolling continued, working lengthwise and diagonally of the street. When practicable, additional compression in the wearing surface should be secured by the use of a ten-ton roller. Rolling must be steadily kept up and continued until all roller marks shall disappear and the surface gives indications of no further compressibility.

The paving shall be done continuously, so the number of joints between the hot and the cold material may be reduced to the minimum. When it is not practicable to lay it continuously and a joint is unavoidable, the edge of the cold material shall be trimmed down to a rough feather edge, and the surface, where the joint is to be made, painted over with bituminous cement, the hot material raked over the feathered edge and thoroughly rolled. Instead of trimming the cold material, joint strips may be used, consisting of strips of canvas about eighteen inches wide with three parallel lines of three-quarter-inch ropes sewed on the under side about three inches apart. The joint strips shall be laid on the feather edge of the freshly raked material with the upper rope at the line where the thickness begins to decrease and the rolling completed on top of the canvas as for the finished pavement. The faces of the curb and gutter, iron castings, etc., shall be painted with bituminous cement before the paving mixture is laid.

*Surface Finish.* As soon as possible after the rolling of the mixture is finished, and while the surface is still fresh and clean, and, if possible, while warm, a seal coat of bituminous cement of proper consistency to be flexible when cold, shall be spread over the surface. It shall be applied while at a temperature of from 200 to 350 degrees Fahrenheit, depending upon the bituminous cement used, and evenly spread with rubber squeegees or mops. Only a sufficient coat shall be spread to flush the surface voids without leaving any excess. Immediately over this a top dressing of torpedo sand, fine gravel or stone chips free from dust, which must be thoroughly dry and heated in cold weather, shall be spread and thoroughly rolled into the surface. A small surplus shall be left to be work in or worn away by the traffic.

In the case of park drives and roadways not subjected to heavy constant traffic, and where a more grainy and coarse surface is desired, the surface finish specified above may be omitted and the following method of finishing adopted:

As the bituminous concrete is raked to grade, and just before the roller comes on it, spread dry stone chips or coarse torpedo sand evenly with swinging motions of a shovel until the surface is barely covered. Then roll thoroughly as specified in the preceding paragraph relating to the method of laying. If bare spots appear under the roller, sprinkle more chips or sand and continue the rolling until the whole surface is fairly covered.

After the stone chips or sand have worn into the surface, the street shall be swept, all excess of surfacing material removed, and the street left clean.

*Asphaltic Cement.* The asphaltic cement may be prepared from the following asphalts combined with flux as hereinafter specified, if flux is necessary:

(1) From refined natural asphalt.

(2) From the residue obtained in the careful distillation, either with or without oxidation, of asphaltic or semi-asphaltic petroleum.

(3) From any uniform combination of the preceding materials, together with a suitable flux, if flux is necessary, such combination being subject to the approval of the engineer.

Each bidder must state the nature and the origin of the bitumen to be used by him, and, further, shall submit samples of the bituminous cement with his proposal.

The asphaltic cement shall pass the requirements designated below:

(1) It shall have a penetration of from 40 to 85 at 77 degrees Fahrenheit, depending upon the traffic and the climatic conditions, and the hardness of the pavement desired. A penetration of from 40 to 50 in most cements will produce a hard, exceedingly stable pavement which should be used on streets supjected to constant or heavy traffic.

A penetration of from 50 to 65 in most cements will produce a pavement best calculated to meet general traffic conditions. The above penetrations are measured in hundredths centimeters, with a No. 2 needle weighted with one hundred grams acting for five seconds.

(2) When fifty grams of the cement are maintained at a temperature of 325 degrees Fahrenheit for five hours in a tin

box two and one-quarter inches in diameter by one and three-quarter inches deep, there must not be volitilization of more than five per cent. by weight of the bitumen present, nor shall the original penetration be reduced thereby over one-half.

The method of test employed is that recommended by the Committee on Coal Analysis of the American Chemical Society.

(3) Of the bitumen of the asphaltic cement which is soluble in carbon disulphide, ninety-eight and one-half per cent. shall be soluble in carbon tetrachloride. In this test for carbenes, the asphaltic cement to be tested should be allowed to stand over night, covered with purified carbon tetrachloride. The test is to be performed in subdued light.

(4) The cement shall not flash at a less temperature than 350 degrees Fahrenheit, New York State Closed Oil Tester.

*Flux.* Use the flux specifications prepared by the Committee on Asphalt Pavement Specifications.

*Coal Tar Cement.* The coal tar cement shall be residue of the distillation of coal tar only, and shall be refined for the special purpose of making a paving cement.

No mixture of hard pitch with the lighter oils of coal tar will be permitted.

Its specific gravity shall be not less than 1.20 nor more than 1.29 at 69 degrees Fahrenheit.

The melting point determined by the cube method shall be not less than 100 degrees Fahrenheit, and not more than 115 degrees Fahrenheit.

It shall contain not less than fifteen per cent., nor more than thirty per cent. of free carbon insoluble in benzol.

It shall be free from water as determined by distillation and shall show upon ignition not more than one-half per cent. of inorganic matter.

No distillate shall be obtained lower than 338 degrees Fahrenheit, and up to 600 degrees not less than five per cent. and not more than twenty per cent. of distillate shall be obtained. The distillate shall be of a gravity of not less than 1.03 at 60 degrees Fahrenheit. The residue shall have a melting point of not more than 165 degrees Fahrenheit. In making this distillation, an eight-ounce glass retort shall be used, and the thermometer suspended so that before applying the heat the bulb of the thermometer is one-half inch above the surface of the liquids. The melting point of the pitch shall be determined by suspending a one-half-inch cube in a beaker of water one inch above the bottom. The temperature shall be raised nine degrees per minute from 60 degrees Fahrenheit. The temperature recorded the instant the pitch touches the bottom shall be considered the melting point of the pitch. In testing the original materials, the initial temperature shall be 40 degrees Fahrenheit.

*Water Gas Tar Cement.* The specific gravity at 25 degrees Centigrade shall be between 1.155 and 1.170.

On extraction with cold carbon disulphide at room temperature for twenty minutes, not less than 97½ per cent. shall be soluble.

When tested in a penetrometer at 25 degrees Centigrade with a No. 2 needle under 100 grams load for five seconds, it shall have a penetration of not less than 27.5 millimeters, and not more than 32.5 millimeters.

When 100 cubic centimeters are distilled in a 250 cubic centimeter Englar flask according to the method proposed by the American Society for Testing Materials, the loss by weight shall be within the following limits:

From start to 170 degrees Centigrade—None.

From 170 to 225 degrees Centigrade—Not over one-half per cent.

From 225 to 270 degrees Centigrade—From 2 to 6 per cent.

From 270 to 300 degrees Centigrade—From 5 to 9 per cent.

Residue—Not less than 84 per cent.

## SPECIFICATIONS FOR BITULITHIC PAVEMENT ON ANY APPROVED FORM OF FOUNDATION.

*Wearing Surface.* On the foundation as hereinabove specified, shall be laid the bitulithic wearing surface and seal coat, described below, so as to have a thickness of two inches after thorough compression. The wearing surface shall be composed of hard, crushed stone, sand and bitulithic cement.

Either of the two following methods and apparatus shall be used in the preparation of the wearing surface.

1. The stone and sand shall be heated in a rotary dryer and while still hot separated into the desired number of different sizes by means of a rotary screen having a minimum screen opening of about one-tenth of an inch, and a maximum opening of about one and one-half inches. The openings in the successive screen sections up to one-half-inch size shall not vary more than one-fourth of an inch, and not more than three-quarters of an inch for the sizes larger than one-half inch. The aggregate thus separated shall pass into a bin having sections or compartments corresponding to the screen sections. From these compartments, the aggregate shall pass into a weigh box, resting on a multi-beam scale. The desired amount of aggregates from each of the above compartments shall be accurately weighed separately on the scale and the batch dropped into a twin-pug mixer, where it shall be intimately associated and thoroughly commingled with a predetermined quantity of bitulithic cement, sufficient to coat all particles of the aggregate and to fill the voids in the same.

2. The stone and sand shall first be carefully measured as to sizes, and a definite quantity of each size shall then be fed into an elevater terminating in a hopper or bin which discharges into a rotary dryer or heater, both hopper and heater being so designed as to keep each batch by itself until heated. From the rotary heater, the batch of mineral aggregate shall pass into a rotary cylindrical mixer containing blades, spirals, or other devices for producing a mixture of the mineral aggregate with a predetermined quantity of bitulithic cement sufficient to coat all of the particles of the aggregate and to fill the voids in the same.

The different sized particles of stone and sand ranging in size from impalpable powder to about one-half the thickness of the wearing surface, shall be combined in such proportions as to secure in the mineral aggregate density, or low percentage of voids, and inherent stability or resistance to displacement, producing an aggregate which, when combined with the bitulithic cement, and laid in place and compacted, will form a street paving structure consisting of mineral aggregate of different sizes and the bitulithic cement which permeates the entire mass, fills the voids and unites the various particles thereof. If the crushed stone and sand do not contain enough finely divided particles, or impalpable powder to produce a low percentage of voids in the aggregate, the deficiency shall be made up by addition of any other suitable fine mineral matter.

The mixture and the ingredients thereof shall be maintained at a temperature consistent with good workmanship. The mixture when reaching the street shall be hot enough to allow of being easily spread and raked, and shall not be so hot as to injure the bitulithic cement.

*Surface Finish or Seal Coat.* There shall be spread over the bitulithic surface mixture a seal coat, using, per square yard of bitulithic pavement, approximately one-fourth gallon of bitulithic cement, into which shall be incorporated approximately twenty-five pounds of mineral aggregate not larger than one-quarter inch in diameter. After spreading the seal coat, it shall be thoroughly rolled into the bitulithic surface mixture. On grades a coarser aggregate may be used.

*General.* Each layer of the work shall be kept as free as possible from dirt, so that it will unite with the succeeding layer.

The bituminous composition, or cement, shall in each case be free from water and shall be especially refined to remove volatile and other matter susceptible to atmospheric influences.

Warren Brothers Company, owners of the patents used in the construction of the Bitulithic pavement, shall file with the proper official or board which is about to receive bids for the work, a properly executed binding agreement to furnish any contractor desiring to bid for the work, all the necessary Bitulithic surface material, mixed ready for use, and Bitulithic cement, and the sand, gravel, or stone screenings for the surface finishing course, in accordance with sections "Wearing Surface" and "Surface Finish," at a definite reasonable price per square yard. Said price shall include a license to use all of the patents required in the construction of the Bitulithic pavement as herein specified.

The acceptance of bids by..... and the letting of a contract for the same shall be deemed by Warren Brothers Company to be an acceptance of its proposal by.....and by the

*(Continued on page 58)*




DON'T CROWD, THERE'S LOTS OF ROOM FOR EVERYBODY (Except, Perhaps, the Hobo)

# Records Smashed in Asphalt Pavement Construction

## Several of the Contractor's Time- and Labor-Saving Methods Described in Detail; Make-up of Gangs

By Stanley E. Bates, Assoc. Mem. W. S. E.

ORGANIZATION and favorable late autumn weather—but mostly organization—made it possible for the American Asphalt Paving Company, Chicago, Illinois, to complete 83,400 square yards of sheet asphalt and asphaltic concrete (Topeka Mix) pavement on what is known as the Yale and Stewart Avenue Systems, Chicago, within a period of forty-two working days, thus establishing a speed record which may reasonably be expected to stand for many years, unless the same company attempts to better it.

An average of 475 men and 175 teams (and teamsters) employed per day (exclusive of four curb and gutter gangs, three sewer gangs, the plant men, etc., totaling over 250 men) contributed largely to this record but without excellent superintendence as applied to the layout of the work, the make-up of each gang and other important details, double the number of men and teams might not have been sufficient for the task; they would merely have gotten in each other's way.

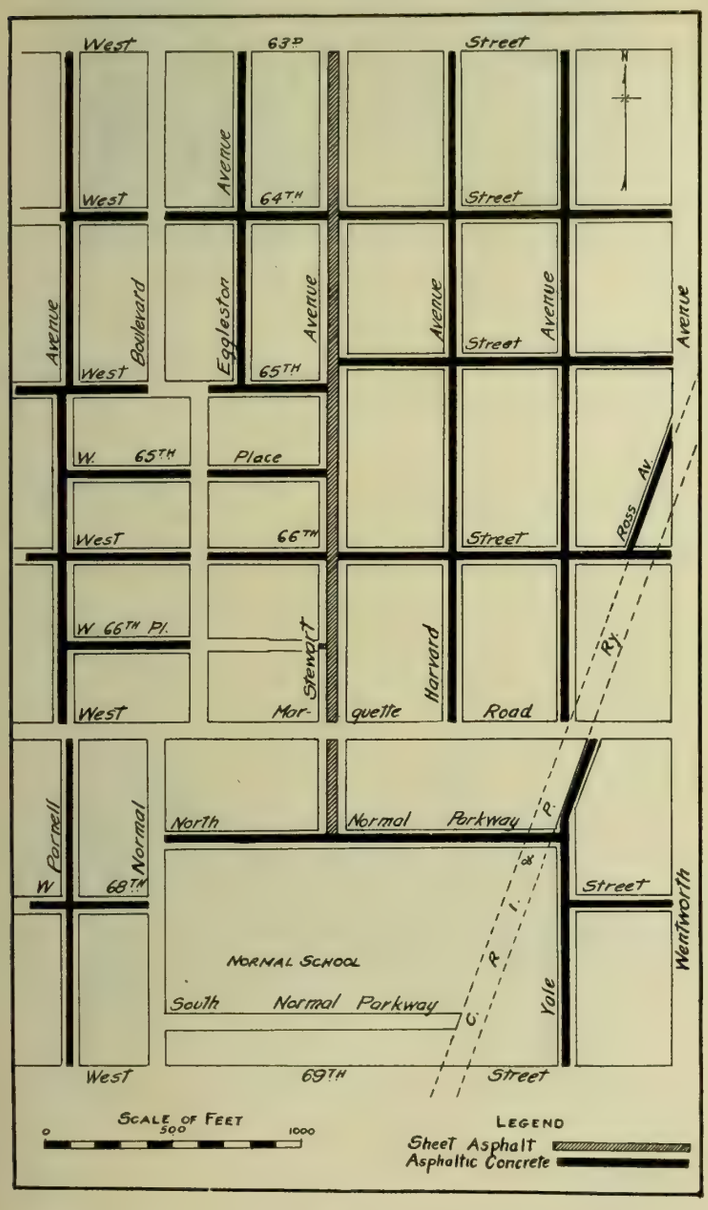



Fig. 2

It goes without saying that the company did not make this speed record merely for speed's sake. The contracts were not let until very late in the fall, October 3, 1915, and to finish up this very large amount of work before the close of the season required exceptional effort. And here the result of past policy of the concern made itself evident and contributed in no small way to the success of the undertaking.

This policy might be characterized as fair dealing with employees, though this does not sum up the situation completely. At any rate, the result is that all of the men, laborers as well as bosses, practically all of whom have been with the company for many years, take pride in the concern they work for, and when the Yale and Stewart Avenue work begun, knowing that there were more than eighty thousand yards of pavement to complete, they all buckled down to the job with an energy that the common variety of "bossing" never could have instilled into them.



A. Yale Avenue before Impovement

The work of both sub-contractors was done with equal celerity and dispatch.

A small sketch of the streets paved is given in Fig. 2. It shows the extent of the work and its compact nature, the area of the entire district being considerably less than one-half square mile. This had its advantages and disadvantages. After the machinery was once on the job there was comparatively little travel to get from point to point. On the other hand, almost all the materials, particularly the sand and stone for the concrete foundation, had to be stored on the streets under construction. This made it a difficult matter so to lay out the work that there would be no confusion; that each of the numerous gangs could proceed with its work without interfering with the work of any other gang; that materials would always be on hand at the proper place and on time; and that as many of the streets would be kept open to traffic as possible. The fact that there are few alleys throughout the district make this particularly necessary.

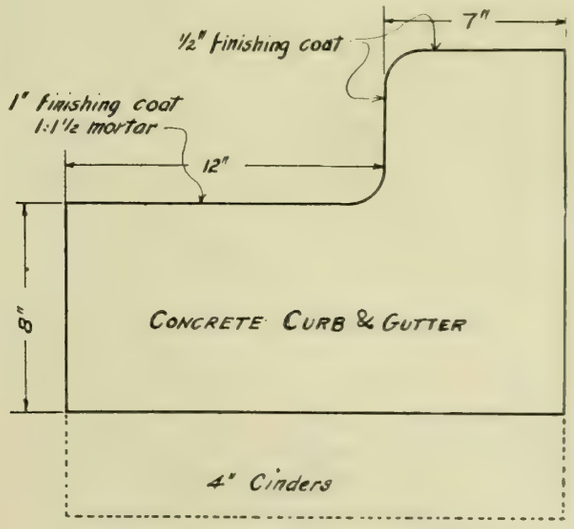



Fig. 3

It would be impossible to describe the entire layout of the work, but in general it was the purpose to keep alternate streets in both directions, open to traffic. With few exceptions this was accomplished. Traffic was allowed on the concrete base about two days after placing; it would have been impossible to keep it off any longer.

The various stages of construction are taken up in order herewith:

SEWER WORK.

The American Asphalt Paving Company sublet all sewer work to the Washington Construction Company, Chicago.

Sewer work comprised the bulding of 189 new catch basins, adjusting to grade of 32 old catch basins and 200 manholes,



E. Corner Protection Bar in Place

and the building of several thousand feet of laterals and connections. The new catch basins were Chicago standard, two rings of brick, four feet diameter, and 7 feet, 2 inches deep, except 30 shallow catch basins about 5 feet deep.

A total of ninety men were employed on sewer work, split up into three gangs as follows:

Gang No. 1. One bricklayer (foreman), one helper, one cement man, twenty-one laborers. Twenty-four men total.

Gang No. 1 did all the work on Stewart Avenue and North Normal Parkway.

Gang No. 2. One bricklayer (foreman), one helper, one cement man, twenty-four laborers. Twenty-seven men total.

Gang No. 2 had all of the work west of Stewart Avenue.

Gang No. 3. One foreman, two bricklayers, two helpers, two cement men, thirty-two laborers. Thirty-nine men total.

Gang No. 3 had all of the work east of Stewart Avenue which necessitated the large number of men in comparison with the other two gangs.

One four-ton Locomobile truck served all three gangs.

Charles McNichol was general superintendent for the Washington Construction Company.

CURB AND GUTTER.

Powell Brothers, Chicago, had the sub-contract for all of the curb and gutter work.

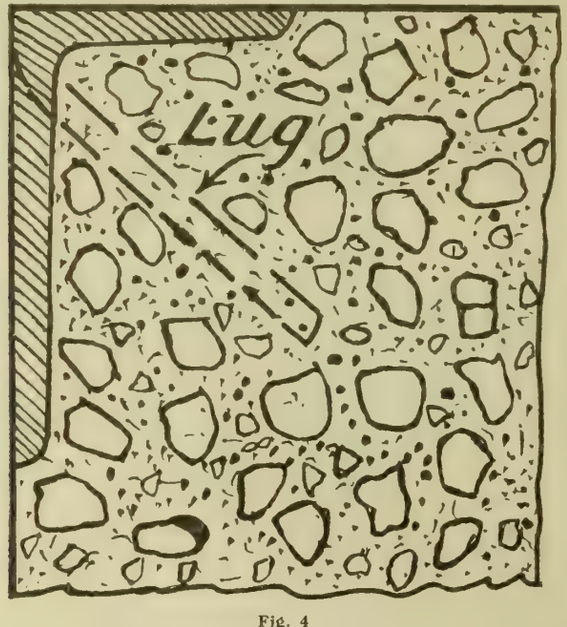



Fig. 4

The old curbs, which were of limestone, were removed, broken up with sledges and hauled away. A cross section of the new concrete combined curb and gutter is given in Fig. 3, which is the standard section of the Board of Local Improvements, City of Chicago.

The aggregate for the curb and gutter was crushed Wisconsin granite and granite screenings, the former varying in size from 1½ to ¼ inches and the latter from ¼ inch down. The mix was 1:2:4.

Mixing was done on pieces of boiler plate steel, and transported to the forms in wheelbarrows. A finishing coat of 1:1½ mortar was placed on the exposed surfaces, one inch thick on the gutter and one-half inch on the top and face of the curb. The curb and gutter was placed on a bed of cinders, four inches thick.

An interesting feature of the curb and gutter construction lay in the use of a new type of protecting bar for the curved intersection of streets and alleys. A cross section of the bar is shown in Fig. 4.



B. Tearing Up Old Macadam Pavement

It is simple in design, made from a single angle of medium steel. Having lugs sheared out and bent back from the vertical leg at intervals of six inches, no bolts are required to keep the bar in place. The lugs are wedge shaped and the wedge action holds the bar so firmly to the concrete that it is impossible to break it out without breaking the curb to pieces.

This type of corner protection bar is the invention of H. J. Fixmer, a division engineer of the Board of Local Improvements, Chicago. They are manufactured by the Universal Concrete Bar Company, Chicago.

Four gangs totaling 130 men were employed on the curb and gutter work. The first gang, twenty-five men including the foreman, removed and broke up the old limestone curbing. The remaining three gangs of thirty-five men each put in the new curb and gutter. The make-up of the construction gangs was as follows:—



C. Screeners Dumping Cleaned Stone

1 Foreman.
1 Finisher.
1 Finisher's helper.
1 Strip setter.
1 Strip setter's helper.
8 Mixers.
2 Men on fine box.
6 Men excavating ahead of strip setters.
8 Wheelers.
2 Lumber men.
1 Curb tamper.
1 Gutter tamper.
2 Cinder men.

—

35 men total.

Altogether there were 49,300 lineal feet of old curb removed and the same amount of new curb and gutter constructed.

Materials for the curb and gutter work were hauled from a near-by railroad yard to the job in 3-yard dump wagons. The Belt Teaming Co., Chicago, had the contract for this hauling and used, altogether, eight teams.

GRADING.

Grading consisted in removing the old macadam pavement and a layer of earth underneath ranging in depth from a few inches to about two feet. To reclaim the old stone for use as coarse aggregate in the concrete foundation, the macadam screeners manufactured by the Briggs-Chicago Company, Chicago, and described in the October issue of BETTER ROADS AND STREETS, were used.

The macadam was first loosened by means of a rooter plow, usually drawn by a road roller, though occasionally by horses. Fig. B shows an Iroquois ten-ton roller pulling an Austin rooter plow on 64th Street.

After plowing, the screeners were brought onto the job. Usually five men comprised a shoveling crew for one screener. The mixture of stone and earth was shovelled up with forks and loaded into the drum of the screener until the latter was about two-thirds full. The machine was then driven to the storage pile, located on a side street, where the cleaned stone was dumped as shown in Fig. C.

The routes of the screeners were always so arranged that they had to travel at least one long block from the point where they were loaded, to the storage pile, to allow all the dirt to sift through the mesh and leave the stones clean.

Two or three men were stationed at each storage pile to assist in dumping the screeners and to sort out and break up all of the large stones with mauls. The specifications called for all stones to be less than three inches in diameter. While in the old macadam many stones four and five inches in diameter were found.

The old macadam streets had received annual treatments of heavy asphaltic oil for several years, which, cementing the upper stones together, in some places formed a mat of considerable thickness on the surface.

Ordinarily this mat would break up in the screeners and the coated stones would not form too large a percentage of the entire reclaimed material. But on a few of the streets where the bituminous mat was of exceptional thickness it was removed by hand to the side of the road and later hauled away to the dump.

After all of the old stone had been removed and the subgrade brought to the proper grade and crown, it was given a thorough rolling with a ten-ton roller, and was then ready for the concrete.

All told, there were six grading gangs working on the Yale and Stewart Avenue systems, though not continuously. Each had about thirty-five men and twenty-five teams, the ordinary make-up of each gang being as follows:

1 Foreman.
1 Timekeeper.
26 Laborers.
5 Finishers.
1 Water boy.
1 Watchman.

35 Total.

In addition, there were two roller operators working on the entire job; one breaking up the old macadam and the second rolling the finished surface for the concrete.

Their equipment of the grading gangs consisted of steam rollers, plows, screeners, dump wagons, tool wagons, forks, shovels, picks and other small tools.

CONCRETE FOUNDATION.

Three 18-cubic-foot capacity Foote concrete mixers were used for the concrete foundation. These were set up at street intersections near the piles of stone described above.

The fine aggregate, limestone screenings, were delivered to the job by motor trucks and stored opposite the stone pile behind the mixer. A local cartage concern, Baer Bros. Express and Storage Co., Chicago, had a contract with the American Asphalt Paving Company for hauling this material. The trucks which were designed to haul coal, sand, stone or similar material, had a capacity of five cubic yards each, and were equipped with both end and side dumping devices. The bodies were built by the Jacob Press Sons Co., Chicago, chassis by the Old Reliable Motor Truck Company, Chicago. One of the trucks is shown in Fig. D.

The aggregates were measured and wheeled to the mixer in barrows in the customary manner. The mix was 1:3:6.

For transporting the concrete from the mixer to the street, one-horse, 20-cubic foot (one mixer batch) concrete carts built by the Briggs-Chicago Company were used. Ordinarily there were about seven carts to a mixer.

TRAINED HORSES.

The horses were trained to go up one side of the road—generally the right hand—over the subgrade to the point where the base was being laid *without any drivers*, returning on the opposite side to the mixer. This eliminated the services of several teamsters.

According to the superintendent of construction, the training of horses for this service is not a difficult matter and takes only a comparatively short time. Once trained, the horses go about their work without any attention from the men whatever. Instances of their stopping along the road (except to get an occasional lump of sugar from some interested by-



D. Delivering the Screenings

stander) or getting onto the wrong side of the street are practically unknown.

In fact, a few of the horses which have been at this work for several years, get to know the work required of them so well that, when they get to the end of their journey, they turn around and back the cart up to the point where the concrete is to be deposited with nothing but verbal assistance from the tamper. As one teamster remarked, "Them hosses git to know mor'n the men a-bossin' 'em." As might be expected, they are all "pet" horses.

Altogether there were three concrete gangs working on the job, the organization of each being about as follows:

1 Foreman.
1 Timekeeper.
16 Shovellers.
8 Wheelers.
1 Cement man.
1 Man unloading cement
1 Engineer.
1 Hoister
1 Man dumping into carts
1 Header man.
2 Grade levellers.
6 Graders and tampers.
1 Water boy.
1 Watchman.

42 Total.

Specifications for Stewart Avenue called for what is known in Chicago as Type B. Sheet Asphalt, namely, six-inch concrete foundation, one-inch binder and 1½-inch top. The paved width was 50 feet.

The stone used for the asphaltic concrete binder varied in size from ¾-inch down. The mix was made in such proportions that the resulting aggregate contained, by weight; material passing a 10-mesh screen, between 25 and 35 per cent., and bitumen in quantity, from five to eight per cent. of the entire mixture.

The proportions of the wearing surface were as follows:

| | |
|---|---|
| Bitumen | 11.0 to 13.5 per cent. |
| Mineral passing 200-mesh sieve | 10.5 to 15.0 per cent. |
| Sand passing 80-mesh sieve | 18.0 to 36.0 per cent. |
| Sand passing 40-mesh sieve | 20.0 to 50.0 per cent. |
| Sand passing 10-mesh sieve | 8.0 to 25.0 per cent. |
| Sand passing 4-mesh sieve | 6.0 to 10.0 per cent. |

Hauling, spreading and rolling the binder and top were done in the usual manner. The specifications called for the surface to be finished one-quarter inch above the gutter flag. To accomplish this, the contractor had steel templets, ¼-inch thick, with lugs along one edge bent down at right angles to the plate. These templets were laid flat on the gutter flags, with the lugs fitting against the edge as shown in Fig. 12. By running the roller across onto these plates, an even and true edge of the asphalt was obtained.

In accordance with common practice, Portland cement was spread over the finished surface of the asphalt. Contrary, however, to the ordinary method of sweeping the cement on with brooms, it was thrown on by a shovel. It is needless to say that the knack of spreading the cement in this manner is not easy to acquire. But, like all the other employees of the American Asphalt Paving Company, the cement spreader was an expert in his line and covered the surface as thoroughly and evenly as could be done by brushing, and in about one-third the time.

All of the streets except Stewart Avenue were paved with two-inch asphaltic concrete (Topeka Mix) on a five-inch concrete base. With the exception of a few narrow streets, mostly paralleling the C. R. I. & P. Ry., the paved widths were made twenty-eight and thirty feet.

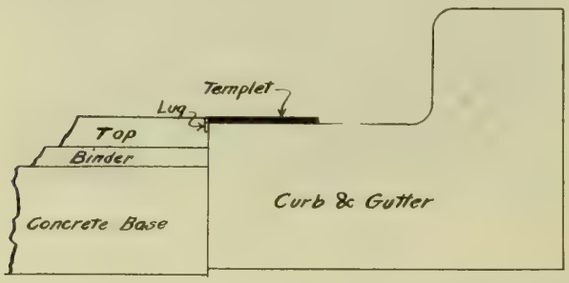



Fig. 12

The asphaltic concrete mixture consisted of asphaltic cement, pulverized carbonate of lime, sand and granite in the following proportions:

| | |
|---|---|
| Bitumen | 8.0 to 11.0 per cent. |
| Carbonate of lime passing 200-mesh sieve | 7.0 to 11.0 per cent. |
| Sand passing 40-mesh sieve | 18.0to 30.0 per cent. |
| Sand passing 10-mesh sieve | 25.0 to 55.0 per cent |
| Broken granite passing 4-mesh sieve | 8.0 to 22.0 per cent. |
| Broken granite passing 2-mesh sieve | 1.0 to 10.0 per cent. |
| Total granite to be | 25 per cent. |

The item designated as "pulverized carbonate of lime passing a 200-mesh sieve" includes, in addition to the pulverized carbonate of lime, fine sand and granite passing a 200-mesh sieve, not exceeding 4½ per cent. of the total mixture, in addition to such mineral dust as is naturally self-contained in the asphalt.

Trinidad and Montezuma asphalts were used exclusively, fluxed with a heavy flux manufactured from Illinois petroleum by the Central Refining Co., Lawrenceville, Ill.

Mixing, hauling, spreading and rolling was done in the ordinary manner. The make-up of the top gang was as follows:

1 Foreman
1 Timekeeper
1 Painter
2 Dump men
6 Shovellers
6 Rakers
2 Tampers
1 Cement man
3 Roller men
2-4 Roustabouts
1 Water boy
1 Watchman

27-29 men total.

In addition, there were 28 to 30 teams hauling the materials, each, of course, with a teamster. The average haul was about three-quarters of a mile from the stationary mixing plant to the job. Only one top gang was employed on the work.

Attention should be called to the fact that three, seven-ton Iroquois tandem rollers were used continuously; once in a while, four.



F. Three Rollers at Work

The total elapsed time from the beginning to the completion of the work (with the exception of a little over a block on which work was delayed waiting for a city water main to be installed) was forty-three days; excluding Sundays, thirty-seven days. In detail, this was as follows:

SEWER WORK—
Begun Oct. 6.
Finished Nov. 11. 37 days.
35 days exc. 2 Sundays.

CURB AND GUTTER—
Begun Oct. 6.
Finished Nov. 9. 35 days.
31 days exc. Sundays.

GRADING—
Begun Oct. 9.
Finished Nov. 13. 36 days
32 days exc. all but one Sunday.

CONCRETE—
Begun Oct. 21.
Finished Nov. 13. 24 days.
21 days exc. Sundays.

TOP—
Begun Nov. 2.
Finished Nov. 17*. 16 days.
14 days exc. Sundays.

*Except six hours on Dec. 1, 1915, putting in 2800 square yards on Eggleston Avenue.

With a total of 83,400 square yards of pavement, the average daily amount of five and six-inch concrete laid was 3,971 square yards. Three gangs were employed, making 1,324 square yards per gang per day. As a matter of fact the average was considerably better than this because three gangs were not working *all* of the time. During the last few days of concreting, only two gangs were at work, and finally, only one.

The maximum day's work on Stewart Avenue was 1,940 square yards of six-inch concrete and on the Yale Avenue system, 2,400 square yards of five-inch concrete.

One gang laid the entire yardage of sheet asphalt and asphaltic concrete top in 14-2/3 working days of nine hours each, making 5,686 square yards per day or 632 square yards per hour.

The work of laying 16,500 square yards of sheet asphalt on Stewart Avenue took 3-2/3 days of nine hours each or 4,500 square yards per day, 500 square yards per hour. The largest day's run was 6,715 square yards of binder and 3,979 square yards of top; total 10,694; combined 5,347.

On the Yale Avenue system, 66,800 square yards of Topeka mix was laid in 11 days or 6,073 square yards per day, 675 square yards per hour. The largest day's run was 6,606 square yards.

The stationary asphalt plant, which turned out all of this material, was designed and built by the American Asphalt Paving Co., and employed between twenty-five and thirty men while the Yale and Stewart Avenue work was going on.

John B. Hittle, Chief Engineer of Streets of the Board of Local Improvements, Chicago, and G. E. Bronson, Division Engineer, were the engineers in charge of the work. E. G. Schwendenan is Superintendent of Construction of the American Asphalt Paving Company and W. H. Lober, Superintendent of Plants and Equipment.

* * *

## Recent Advancement in the Construction of Brick Pavements*

By Wm. C. Perkins, M. Am. Soc. C. E., Chief Engineer, Dunn Wire-Cut Lug Brick Co., Conneaut, Ohio

DURING the past few years, municipal and highway engineers have been investigating the integral parts of brick pavements, and endeavoring to improve each part as to design, material, and construction. New theories have been advanced and tested in the laboratory and in actual service. The leading universities of the country have been willing to co-operate with the use of their laboratories and the advice of the trained faculties of their municipal and highway schools.

The busy city engineer has been using his old design, his old specifications, and the construction has been inspected, if inspected at all, by untrained men, generally political heelers; but this condition of affairs has now changed, the paving engineer asks "Why." He will no longer follow any set of empirical rules or specifications; he thinks for himself, but is always willing to be shown.

Highway engineering has thus become a distinct branch of engineering, and its prominence is shown by the attention given it by the engineering and scientific societies of the country.

There are four distinct parts of a brick pavement:

Subgrade.
Foundation.
Bedding or Binder Course.
Wearing Surface.

Engineers are giving considerable attention to the subgrade of a pavement. Investigations are made as to the nature and bearing value of the soil; all springs or ground waters are taken care of; it is thoroughly rolled, and every effort is made to keep the subgrade free of water, unyielding, of uniform density, and of proper grade and cross-section. This is a distinct advancement over the old, haphazard way, and is of utmost importance, for many of our older pavements show the results of a water-soaked or badly prepared subgrade.

For the foundation course, the engineer must design for durability and economy. The type of foundation depends, therefore, largely upon local conditions—climate, traffic, subsoil, availability of stone, gravel, or other suitable materials. The foundation should be designed to carry the load placed upon it and should be no deeper than is necessary to do this work.

In the South, many pavements are laid directly on a puddled sand subgrade and are giving good results; but in that section where this type of construction is used, there is no frost action and the traffic is light. Foundations of compacted gravel have proven satisfactory in Cleveland, Ohio, and other northern sections; but for general use, a foundation of concrete, so proportioned that 6 cubic feet of concrete in place will contain one bag, or 94 pounds, of cement, is the foundation recommended by most engineers. Metal reinforcement is often used over an unstable subgrade or a lately filled trench. Engineers have also discovered that the smoothness of the finished pavement depends largely upon the smoothness of the foundation, and its uniform distance below the finished contour of the pavement.

One of the greatest advancements in brick paving construction has been the elimination of the cushion of sand between the foundation and the brick wearing surface, and the substitution of a bedding or binding course, of a mixture of cement and sand, not over one inch in thickness. This binding course should be considered as a part of the foundation; for example, if a five-inch concrete foundation is needed, it should be designed four inches of concrete and one inch of cement-sand.

The advantages of the cement-sand bed, and the disadvantages of the cushion of ordinary sand, have been pretty fully discussed in the technical papers and before the engineering and scientific societies. It has been proven that many failures in brick pavements can be traced to the cushion of sand; that "resiliency" is a term which should not be applied to a brick wearing surface; that the sand cushion does shift, yield, and is compressed by traffic weight, leaving small air spaces under the brick wearing surface; that air spaces under the brick surface are also caused by variations in the dampness of the sand cushion, the sand shrinking when drying. These small air spaces cause the pavement to rumble under traffic, and also become weak spots where eventually there may be a settlement in the event of the breaking of the bond between the bricks.

Laboratory tests have shown that mere weight will not crush a brick wearing surface laid on a rigid foundation, provided the bricks have an even bed.

The plain sand cushion was objectionable because of the many hazards of construction. The old specifications give elaborate directions for its compression, but engineers have found that to obtain good results in actual practice was almost impossible, and that what was generally obtained was an unstable layer of sand varying in compactness and thickness between a solid foundation and a solid wearing surface. It was also difficult to prevent the sand from working up between the joints of the brick wearing surface, and thus reducing the depth of the bond. This inequality of hardness of the material in the joints of the brick causes a shearing action, tending to crush the top of the bricks.

There has also been the hazard of weather conditions. Rain falling upon the brick before they have been rolled very often necessitates the relaying of the brick, as it is liable to undermine the cushion and wash it into the joints.

In view of these constructional hazards, the engineers ask, "Why use a cushion; why not use a cement-sand bed with its many advantages?" The construction is simple: the cement and sand properly proportioned (a mixture of 1 cement and 4 sand being recommended), should be placed dry in a machine, or on a mixing board, and thoroughly mixed until a uniform color is obtained. It is then spread, approximately one inch in thickness, on the prepared foundation, compressed with a roller weighing about 300 pounds, and struck off by a template to the true contour of the pavement. If any depressions develop, they should be filled and the cement-sand bed again leveled and rolled.

The bricks are immediately laid, inspected, and rolled. The rolling must follow closely the laying, and all bricks laid must be rolled before the close of work. It is not absolutely necessary to apply the cement filler the same day, for the brick surface is safe from hazards of weather conditions as soon as it is rolled.

The pavement should be thoroughly wet down with a spray just ahead of the grouting. This sets up the cement-sand bed and insures an even, solid bearing for the brick and at the same time practically joins the brick wearing surface and the foundation together; and thus we have a more or less monolithic construction.

The theoretical monolithic construction, but one which is also thoroughly practical and easily built, is obtained by laying the brick wearing surface directly on the freshly laid concrete foundation.

The concrete foundation is finished to the proper grade and contour by means of a simple wooden tamping or striking template of the proper cross-section. This style of template can be easily moved along the side forms with a slight tamping motion, and this will bring the matrix of the concrete to the surface, and thus a smooth, even bed for the bricks, of proper grade and cross-section, is obtained.

If the street is too wide to allow the use of a template for its entire width, the foundation can be formed in sections, using the same style template on [illegible]ding strips set to the

*Read before the American Association for the Advancement of Science, Section D, at Columbus, Ohio, December 29, 1915.

proper grade, and with small stools or bridges for the men to stand upon in the finished base. The strips and stools are easily moved from place to place, and the small depressions left in the finished base can be filled and brought to proper grade and contour by hand luting.

The laying of the brick follows closely; the brick should be laid, inspected, and rolled before the cement has obtained its initial set.

For rolling the brick surface, a hand roller about 30 inches long and 24 inches in diameter and weighing from 600 to 900 pounds should be used. The rolling should be kept close to the laying and be continued until a smooth surface is obtained. At the end of the day's work, the brick-laying, inspection, and rolling should be completed with the limit of the finished foundation.

One of the merits of this type of construction is that the concrete foundation, laying, and rolling of brick are done at the same time, thus there is a saving of time in construction, and the improved pavement is ready for traffic in much less time than under the old form of construction.

For country road work, or improvements where an edging or flush curb is used, the laying of brick directly on the concrete foundation is strongly recommended, as thereby the edging or curb can be omitted, thus reducing the cost. Tests and practice have shown that the bond between the brick and foundation is amply strong to protect the edges of the roadway from the shocks of traffic.

There has also been a marked advancement in the construction of the brick wearing surface.

Previous to 1910, all bricks used for paving purposes had been either plain wire-cut brick or the so-called repressed brick. Engineers appreciated the advantages of the lugs on the side of the repressed bricks, but objected to their nonuniformity; objections were also made to the rounding of the edges, which made it difficult to obtain a smooth pavement. To meet these objections, a wire-cut lug brick was devised, with its rough sides, square edges, and uniform lugs. Its many advantages were at once recognized by paving engineers and its adoption as a paving material has been general.

Recently, the size of paving brick has been standardized. It had been claimed that paving bricks being made of different varieties of shales could not be made the same size on account of the requirements of burning. The Dunn Wire-Cut Lug Brick Company proved that this was a fallacy, the result being that the twenty-seven or more independent companies licensed to make wire-cut lug bricks are making a standard size brick, 8½ inches long by 3½ inches wide, and which lay in the pavement forty to a square yard. This is of considerable assistance to the paving engineer, in the making of minor repairs or for paving over "cuts."

Again the shape of the brick is changing; many bricks are still made with square ends, some containing a small circular groove; others omit the groove. The square-end bricks when laid in a pavement theoretically touch each other on a plane and do not allow for proper penetration of filler.

The standard wire-cut lug brick have a double bevel or bulge of $^3/_{32}$ inch on each end. These bricks when laid in a pavement theoretically touch each other on a line at the center with an opening of $^3/_{16}$ inch at the top and bottom which allows a perfect penetration of the filler. Experiments made on slabs of square end bricks, and bulged end bricks, by the State highway departments of New York and Pennsylvania, in 1914, proved that with the bulged end bricks the penetration of the filler was uniform and the bond obtained many times stronger than with the square end. The tests also proved that the small circular grooves were of little or no value, as the filler did not penetrate them.

Since the advent of the cement-sand bed, there is a tendency among paving engineers to reduce the depth of the brick wearing surface. No brick pavement has ever failed by the actual wearing away of the brick.

One thousand standard paving brick 4 inches in depth weigh 5 tons; consequently, when bricks are shipped for long distances the freight charges are heavy. Standard wire-cut lug brick can be and are being made 3½ inches in depth, and for highway work even 3 inches in depth. These bricks having square edges, insure a uniform bond the entire depth of the brick. Where local conditions warrant this reduction in depth, a considerable saving is effected in freight, haulage, and material.

Special shapes are made for use on grades in order to give a foothold for horses. Here again there has been advancement. The old method of beveling one edge of the brick was not satisfactory. All wire-cut lug hillside brick are made with a series of shallow grooves on both faces of the brick, so that either face can be used in the pavement. These small grooves or indentations furnish a good foothold anywhere on the pavement for the horse, and as the grooves do not run continuously across the pavement they do not increase the traction force.

These bricks are laid longitudinally; that is, parallel with the curb or edging line. This manner of laying a pavement is a radical change, but it has its advantages. The bricks follow the alignment of the street or highway and there is no "batting" required either at the curb or across the street, at angles or curves. Where this manner of laying has been used, it has proven satisfactory; but I will not prophesy, if it will become general for all brick pavements. Engineers are still investigating.

There has been considerable advancement in the application of the cement grout filler. The sand to be used is carefully studied, and grade specified; the amount of water to be used is determined and regulated. The use of a small batch mixer, properly equipped for grouting, is recommended for the application of the first grout. Proper boxes and squeegees are provided for the second application. Inspectors have strict orders to see that the joints are filled flush with the brick, so as to insure a smooth pavement. Traffic is regulated so as not to disturb the pavement. All this is a distinct advancement over old methods.

What about the future? There is still plenty of room for advancement. Engineers should be able to obtain mathematically the strains and stresses in a pavement, and thus be able to design a pavement as they would any other engineering structure. The use of a cement-sand bed, or the laying of the brick on the green concrete foundation, opens up a field for the economic design of pavement.

The cement grout filler, while it is the most serviceable, durable, and sanitary filler available, has its faults, so here again is a field for investigation. In fact, every part of a pavement—from the drainage of the subgrade to the brick wearing surface, should be examined, tested, and investigated, and efforts made to advance if possible to such a degree of scientific assurance that there will be no such thing as a failure in construction.

* * *

## Relative Advantages of Flat and Crowned Subgrades for Concrete Pavements*

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IN THIS paper, an endeavor has been made to diagnose the salient features of subgrade construction as they pertain to concrete pavements. It is hoped that such a discussion will open up a field for further investigation along these lines. This is important not only for the advancement of science, but from a practical standpoint in solving the difficulties presented in the construction of concrete paving. The growth of the good-roads movement has been rapid and the steady increase in the adoption of concrete pavements as a solution of new highway problems brought about by changed traffic conditions, is of great significance.

In the heterogeneous mass of available data, few reports having a bearing on this subject were of practical value. Most of these were incomplete and unauthentic or were worthless for comparison because of the many variables encountered. The construction of a concrete road is materially affected by many conditions, such as climate, drainage, subsoil, materials, workmanship, and dimensions. None of these are the same or bear the same relation to each other on separate work. Furthermore, the success of the completed road is, in part, dependent upon varying conditions of weather and external forces such as traffic and floods. These many variables preclude the possibility of accurate or reliable deductions by comparing available data.

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Six types of cross-sectional design have been used for concrete paving:

1. A uniform thickness of concrete, the subgrade being crowned the same amount as the concrete surface. This was generally adopted up to the year 1911.
2. A greater thickness of concrete at the center than at the sides, with the subgrade flat. The county commissioners of Wayne County, Michigan, adopted this type in 1911 and the design was followed elsewhere.
3. A greater thickness of concrete at the center than at the sides, some crown being given the subgrade. This was fundamentally for the sake of economy in wider pavements in which reinforcement was used.
4. A greater thickness of concrete at the center than at the sides, with the crown in the surface of the subgrade inverted. This is not a popular type but has been used.
5. A uniform thickness of concrete, with the surface of the concrete and the subgrade each having the same amount of inverted crown. This type has been used for concrete alley construction.
6. A greater thickness of concrete at the center than at the sides, with the inverted crown in the surface of the concrete less than that in the subgrade. This type has also been adopted for alley construction.

Let us now consider the probable causes of this variation in cross-sectional design. The first design, that of a uniform thickness of surfacing placed on a crowned subgrade, is a type long used in road construction for macadam, sheet asphalt, brick, wood and asphalt block pavements, etc. The changes in design of concrete pavements were influenced by a number of causes, which will be discussed in order:

1. Drainage.
2. Increasing the life of the pavement.
3. Economic considerations.
4. Adoption for city pavements.
5. Introduction of reinforcement.
6. Elimination of cracks.

### DRAINAGE

Proper drainage is the primary essential in road construction. The shape of the cross-section has been effected by the topography of the country, as this influences the surface drainage and the necessity of carrying away ground water by the immediate vicinity of the pavement. Retention of water by the subsoil must be prevented, otherwise there will be resultant changes in volume, as well as mechanical action on the subgrade, shoulders, etc. This consideration has governed the cross-section of all types of roads. The relation of drainage to the character of the soil has further effected cross-sectional design. Soils of varying elasticity and bearing value have tended to increase the structural strength of the slab. Such increased strength was obtained by increasing the thickness of the concrete at the center. As the low crown of the concrete pavement is a decided advantage for this type of construction, it was inadvisable to increase the crown. The result was the adoption of the flat subgrade or the remote use of a dished subgrade. Drainage is also dependent upon climatic conditions, such as extreme changes in temperature or atmospheric conditions, or where roads are subjected to heavy rainfalls, or when built in arid districts with a scarcity of water. The desire for increased structural strength may be also attributed to these causes, which has tended to bring about the introduction of a flat or dished subgrade.

### INCREASING THE LIFE OF THE PAVEMENT

An increased thickness will prolong the life of a pavement. This, however, is desirable only up to the point where the increased cost offsets the additional efficiency gained. The durability of a concrete pavement is essentially contingent upon the use of properly selected aggregates. In a one-course pavement, the desire for increased wear has not materially affected the design. In the two-course pavement, however, which is an economic solution for localities where the prohibitive cost of suitable aggregates precludes their use, the design has been affected by the selection of the aggregates. The base course is composed of aggregates of less abrasive qualities and, as a rich mix is not essential, practice has led to an increased thickness of the slab.

The personal element is a decidedly important consideration in concrete road construction. It may be that efficient inspection is considered too expensive. If contractors, in their desire to obtain more than their just returns, do not intend to carry out the terms of the specifications, the superintendent or foreman may purposely violate them. Furthermore, political considerations may affect the characer of he work. Hence the engineer has designed a thicker slab as an additional factor of safety. Again the desire for increasing the life of the pavement has been expressed in a change of design. All of these causes have been instrumental towards increasing the structural strength of the slab with the resultant change in the shape of the subgrade surface.

### ECONOMIC CONSIDERATIONS.

Economic considerations have probably been the foremost cause for altering the design of the concrete pavement. The amount of grading and rolling necessary to obtain the desired sub-grade is predetermined by the condition of the foundation. There have been cases where a concrete road has been laid on a former roadbed without changing its shape, and, in other instances, concrete roads have been built on a former roadbed by merely building up at the sides. Both of these cases need only a slight expenditure for the preparation of the sub-grade. Furthermore, the shape of the sub-grade has been directly affected by the saving in the amount of concrete required for the pavement. The design of the original slab of uniform thickness, laid upon a crowded sub-grade, was not governed by economic considerations based upon the amount of concrete required. The change in design to the additional thickness in the center with the flat sub-grade, as heretofore mentioned, demanded an additional amount of concrete. When this increase in concrete assumed large enough proportions to make the additional cost an important consideration, measures were taken to decrease the cost. This brought on a reversion to the crowned sub-grade, expressed either in a slab of a uniform thickness of concrete, the sub-grade being crowned the same as the concrete surface, or in a slab with a greater thickness at the center than at the sides, leaving some crown in the sub-grade.

### ADOPTION FOR CITY PAVEMENTS.

The adaptability of the concrete road for municipal paving was an important factor in changing the design. An increased width pavement was fundamentally essential to fit existing conditions and to accommodate the increase and distribution of traffic. The increased stresses, caused by the longer lever arms, were responsible for an increased thickness at the center. The live load stresses, due to the amount and distribution of traffic, required an increased resisting moment. This was also obtained by increasing the thickness at the center. For the sake of economy the sub-grade crowned less than the concrete surface was again preferable to the flat sub-grade. For instance, a concrete pavement fifty feet wide should be crowned approximately six inches. If the concrete were made six inches thick at the sides, the flat sub-grade would mean twelve inches of concrete at the center. By crowning the sub-grade four inches, giving a thickness of eight inches at the center, there is obtained a saving of practically 25 per cent. in materials and labor over the pavement placed on a flat sub-grade.

### REINFORCEMENT.

Reinforcement has been widely adopted as an additional factor of safety because experience has indicated the desirability of reinforcing under certain conditions. Reinforcement adds to the structural strength of the slab, provides a greater resisting moment in wider pavements, assists in preventing the formation of cracks due to internal stresses, and impedes the further opening of cracks if they should occur. This has resulted in a change of design because the use of reinforcement necessitated a higher cost of construction. To offset this increased cost the cross-sectional area was decreased as it was not considered that the same amount of concrete was necessary. The design then reverted to one of uniform thickness with a crowned sub-grade, consistent with economic requirements and affording increased strength.

### ELIMINATION OF CRACKS.

The success of the concrete pavement has been judged to a considerable degree by the prevalence of cracks. This

is an erroneous impression and cracks do not detract from the value and integrity of the pavement, if properly taken care of, except, in so far as they affect the surface appearance. This is shown by the phenomenal development in this type of pavement, the successful treatment of cracks, and the fact that many pavements, although containing cracks, have given years of excellent service with a minimum cost of maintenance. The notable concrete pavements of Wayne County, Michigan, demonstrate this fact. Public opinion, nevertheless, has augmented this theory to the extent that it warrants fuller discussion in a paper of this nature; and, in order to clearly comprehend the significance of cracks in concrete pavements it devolves that we must analyze the causes.

Volumetric changes due to the hydration of Portland Cement have been considered one of the foremost causes of cracking. This is effected by high and dry winds, extremes in temperature, the addition of foreign matter and the porosity of the aggregates—all of these internal stresses before the concrete has attained sufficient strength to withstand them. The formation of cracks of this character have been and can be prevented by the observation of proper precautions. Ordinarily such cracks, commonly referred to as shrinkage cracks, appear only on the surface. They are usually unnoticeable after the pavement is open to traffic and are in no way injurious. The Roosevelt-Woodbridge road near Port Reading, Middlesex County, New Jersey, laid in 1914, is an admirable example. All of the above causes may have contributed in developing shrinkage cracks on this road, noticeable at the time of construction, nevertheless, after one year's service under heavy traffic, these cracks are not discernible.

Volumetric changes also occur after the concrete has assumed a reasonable degree of hardness. These are induced by fluctuations in temperature, and variations in the moisture content dependent upon the density of the concrete. This is determined by the selection, proportioning, and mixing of the materials of construction. The experimental concrete road at Chevy Chase, Maryland, built by the Office of Public Roads, in 1912, is a demonstration of cracks due to this cause. The average distance between transverse cracks varies from 45 feet in sections where gravel was used to 145 feet where limestone constituted the coarse aggregate. Unless provision is made by the use of reinforcement and the proper spacing and installation of joints, cracks are liable to occur. Such cracks extend generally perpendicular to the center line. The Morris Turnpike, near New Village, Warren County, New Jersey, built in 1912, is a representative example of this. The charts prepared by the United States Bureau of Standards illustrate clearly the changes due to the above causes. The results of measurements of linear changes, made during the period from October, 1912, to October, 1913, show that an increased length of slab accompanied a rise in temperature and an increase in the moisture content. The maximum expansion recorded was 0.035 feet per 100 feet. In this case the close spacing of joints (about 30 feet) prevented, to a large degree, the formation of transverse cracks,

The character of the materials composing the sub-grade materially affects the monolithic nature of the superimposing slab. The effect of the porosity or capillarity of the soil is illustrated by the North Andover Road, Essex County, Massachusetts, built in 1913 on an old macadam base. Gravel was used to build up the sub-grade on parts of the road. From a diagram prepared by the Massachusetts Highway Commission, Mr. Andrew N. Lovis, First Assistant Engineer, draws the conclusion that "where no gravel was placed beneath the concrete or where the concrete was not reinforced, the cracks developed on the road proportionately to the amount of frost action." The elasticity of the soil may have its effect as in the case of the "black earth," prevalent in some sections of Texas. Cases have arisen, notably in Dallas, Texas, where concrete pavements, which have been laid upon an over-compressed sub-grade, have been elevated and badly cracked by the subsequent expansion of this earth.

The rigidity of the sub-grade is an important feature. The Easton Road at Nazareth, Northampton County, Pennsylvania, was built in 1913, partly on an old Telford foundation, the voids of which were filled with old concrete, and partly on an old concrete road. This road has withstood a heavy traffic for four years without a single longitudinal or diagonal crack and only two short transverse cracks. The other extreme would be in the case of a sand sub-grade subject to lateral flow, which would undoubtedly cause cracks in the concrete slab. Rugosity of the sub-grade, causing increased frictional resistance, would affect the superimposing slab. No records are available where cracks can be traced to this cause alone, but it undoubtedly has an appreciable effect. To prevent cracks due to this cause, it is essential to have the sub-grade in a comparatively smooth condition. All of these characteristics, if developed to a sufficient extent, tend to cause cracking. Such cracks are usually parallel and in close proximity to the center line and have been practically eliminated by the use of reinforcement and an increased structural strength.

Restraint of the free movement of the concrete slab is in itself an ineffectual attempt to control physical forces. This may be due to restraint at the shoulders, or restraint due to the fixed position of rigidly anchored manholes, catchbasins, or standpipes. Cracks induced by these contingencies do not follow any general direction, but, as a rule, are influenced by the nature and position of the obstruction. Observation has shown that these cracks tend to extend in a diagonal direction especially when due to the latter aforementioned obstacles of restraint. Examples of cracks due to this cause are too numerous to require an illustration and such cracks can be prevented by the introduction of an elastic cushion. Although reinforcement is not an initial preventative against cracks of this character, it is of value in stopping the further opening of the cracks. Obviously then reinforcement with an increased structural strength of design has been resorted to in an endeavor to eliminate cracking. This desire to prevent cracking, therefore, has been a secondary cause in the logical evolution of the cross-sectional design, and has expressed itself in the previously discussed shapes of sub-grade with the occasional and experimental use of the inverted or dished sub-grade.

It is apparent then that the shape of the sub-grade has been influenced more by other causes. The structural strength of the pavement and the composition of the sub-grade materials have been given primary consideration in the design of concrete pavements. The available data substantiates this and the preponderance of the variables entering into this data precludes the possibility of arriving at definite conclusions as to what effect the cross-sectional shape of the sub-grade has upon the integrity and durability of the concrete pavement. However, the shape of the sub-grade has had in some cases a direct bearing upon the shape of the superimposing slab, and the relative importance of this would be of great value in determining how much weight should be given to the shape of the sub-grade in its effect on the design.

Both the Bureau of Standards of the United States Department of Commerce and the Office of Public Roads of the United States Department of Agriculture are now conducting a series of tests under varying conditions of sub-grade, to determine the relative importance of the sub-grade conditions as effecting concrete pavement design. From the results of these experiments, after the elimination of other variables, it is hoped that more definite conclusions may be reached as to the relative advantages of flat and crowned sub-grades for concrete pavements.

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## System Applied to Street Management*

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STATE highway departments, collegiate institutions, and even the Office of Public Roads of the United States, have deemed it advisable to construct various types of roads, and roads of like type of somewhat different construction, with a view of study, recording data, watching behavior, keeping a correct cost, maintenance and repair charge, comparing wear and tear in an endeavor to reach some conclusion and gather some testimony as to the worth and value of such roads respectively. This endeavor on the part of these organizations is perhaps an effort as nearly practical as possible under existing circumstances. Still, in every effort of this sort, one's conclusions are drawn but from one character of travel. It is necessarily alike over the various sections. No law of averages can be applied and the *best results* reached after

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years of study are of doubtful character. The conclusions are reached from conditions that are widely different from those actually existing on our streets as a whole, no one of which bears the same travel. The effort itself, largely artificial, does suggest, however, that no actual condition has been put to any practical purpose from which correct conclusions might be reached. And it does strongly suggest that the information sought is of great necessity.

Why cannot information of this character be obtained in a more practical and scientific manner and the information itself afford greater reliability and more adequately meet the necessities of the case?

There is no plan of street and road management or street administration that can be called fundamentally efficient for the reason that no plan of management exists that includes in the construction, maintenance, and repair, the availability of the information sought by the building of these so-called experimental roads.

Streets which are improved are of various types.

They are in various states of repair.

They are of various locations.

Even a single street receives a variety of travel.

Single streets are often of such location that sections receive more or less travel.

The streets overlie varied conditions of soil.

Some streets are susceptible of easy natural drainage.

Other streets must receive artificial drainage.

The choice, the character, the type, the cost of all, are subject, to a greater or less extent, *to the whim, the notion,* to the cheapness of cost, *influences of zealous promoters,* sometimes secured by one neighbor selling out another—in almost every case chosen from any consideration other than the ones upon which good, sound judgment *should be exercised*—these streets representing one great mass of unknown conditions, evidence simply a lavish expenditure of money known to us as the streets of *this city* or *that*—roads of this county or that.

But few of these streets and roads have a legal name, most of them bear merely a nickname. None of them bear any identification whatever or relationship to commercial accounting such as is found in every well-regulated commercial establishment. The original investment, as to its parts or its whole, is not of record, is not charged; cost of upkeep is so confused with general charges against the whole lot that no knowledge whatever is obtainable as to the amount expended on any street or road, and we do not even know the actual reason for the expenditure, whether it was on account of repair due to wear and tear, on account of some defect of original construction, on account of accident, on account of some cut and opening, nor does any record disclose whether the street or road has remained out of repair or whether repair was needed, or whether the street or road has cost in repair an amount exceeding any justification for maintaining a road wholly inadequate for the travel and traffic that passes over it.

This chaotic and inexcusable street and road mismanagement has been allowed existence because streets and roads are sustained by donation in some one form or another, their earning capacity is not held to account. In a commercial establishment, if a like manner and method of conducting was permitted, the institution would soon fall into bankruptcy. A department, a machine under such loose methods would continue in operation as a loss and escape detection. No information as to the value, the worth, and economy of any tool or apparatus would be possible upon which improvements could be suggested and undertaken.

What business plan is there, therefore, of street and road management that could be put into operation which would serve immediate and emergency needs equal to any plan now in existence, and at the same time furnish such accurate information as to original cost, cost of operation and service, usually designated as maintenance and repair, the application of such supervisory oversight as that when a break occurs it could at once be determined whether or not it was due to wear or tear or an original defect in some part? Dealing systematically with cuts and openings and replacements to effectually regulate to the greatest advantage of the street, that annoying privilege.

Separate these streets in certain divisions and these divisions into sections, of in no case exceeding one mile in length. These sections must be measured, numbered, and recorded for the purpose of complete identification. To illustrate: East 45th Street, Division No. 9, Section 17, beginning at the north property line of Superior and ending with the south property line of St. Clair, including intersections therein, 4,800 feet in length.

You can then treat that particular section of street as a thing, a piece, as a machine, from which you can extract information of every kind and character. Similar information can be gathered in like manner from every street within the corporate limits of the city. With the information in hand, which is possible to gather under such a plan, the adaptation of streets of type and kind for the varied services, in a short time will become apparent not only to the student applying a refined study to the situation, but to the layman as well.

Every county should be required by law to establish a complete identification of roads within the county by section number, of lengths not exceeding two miles, and location by township, and such identification should be made of record and in all cases of contract, maintenance and repair, expenditure therefor should be made and charged as against the particular section upon which the expenditure was made. By such a plan of road and street management, the greatest possible economy would at once become apparent by the ability to trace the actual dollar to the thing purchased for the particular road. Aside from this benefit, data, experience, and comparison would become available for future judgment. Street and road improvements, maintenance and repair would at once become a scientific, systematic, business-like operation, and wasted millions would be saved.

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## Identification of Bituminous Materials*

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ON ACCOUNT of the complex nature of hydrocarbons, the various methods and appliances used in testing and the variable results obtained in different laboratories due to the personal equation or compounding of bituminous materials, make the positive identification of any particular bituminous material a very difficult task.

As is the case with practically any substance or material found in any section of the country or world, bituminous materials from different sources have certain particular characteristics due to the locality or source from which they are obtained. By careful testing, and tabulating the results obtained from a large number of samples from different sources, these particular characteristics are detected and it is possible for any individual laboratory making repeated tests to positively identify a great many of them. In order to better explain these distinctive characteristics of bituminous materials, especially those which are used in the construction of roads and pavements, waterproofing, insulation, etc., the writer will first endeavor to classify them through their source and then give the particular characteristic of the material derived from these different sources.

### BITUMENS DERIVED FROM PENNSYLVANIA AND OHIO OILS

As the Pennsylvania oil was the first discovered in this country, it is natural that the first bituminous materials produced in this country were produced from the residuum of the Pennsylvania oil fields; and, while these bitumens were never successfully used in paving and road work, yet they were the beginning and foundation of the first bitumens used in insulation, waterproofing, etc., and from the results obtained from these Pennsylvania residuums a large and prosperous industry has developed and even to-day Pennsylvania residuum can be used most advantageously in preparing certain bituminous products.

There is no definite information as to just how and when the first Pennsylvania residuums were used; experiments, however, were made on these residuums by Francis X. Byerley, of Cleveland, and considerable work was done on these bitumens by Professor Maybury in conjunction with Mr. Byerley's experiments.

The Ohio field was the next oil field of any considerable size to be discovered, and it was from the residuum derived from this oil that the first artificial bitumens or asphalts were made. In the early development of the oil industry, the resid-

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uum derived from this oil that the first artificial bitumens or asphalts were made. In the early development of the oil industry the residuum from which the bituminous materials were made was of a poor quality, being badly cracked or overheated, and the resulting bitumens were of a very poor quality. They had, however, certain peculiar characteristics by which even to-day they could be identified. For example, the materials made from the Pennsylvania and Ohio fields had a comparatively light specific gravity, a heavy percentage of paraffin and high fixed carbon.

Bitumens produced from the Pennsylvania and Ohio fields to-day have, in a way, the same characteristics; they are light in specific gravity, heavy in paraffin content, greasy in appearance, and have practically no adhesive quality, or what may be termed in other words, no tensile strength. The fixed carbon, however, has been reduced until it is now the lowest of any of the bituminous materials. This variation in the fixed carbon is due entirely to the improved process of refining. This fact is of particular importance to note, as it is one of many cases where distinctive characteristics are changed due to improved methods of production, and a test that may to-day identify a material may to-morrow be obsolete.

While very little of the Pennsylvania and Ohio materials are used in road making, there is a considerable amount used in compounding and these compounds are produced under various conditions. In some instances, the oil is treated with air for various lengths of time and then combined with other bituminous materials for the making of waterproofing, insulation, and other special bituminous compounds, and each of these has its own particular characteristics.

BITUMENS DERIVED FROM CALIFORNIA OIL

The California oil field was one of the first fields in this country from which any bituminous material was produced in any quantity for the purpose of road building. The California oils are particularly adaptable for the production of such materials. They are very unlike the Pennsylvania and Ohio oils, having a distinctive asphaltic base, practically no paraffin, and are very adhesive or sticky. Most of the bituminous materials produced with California oils have been produced by what is known as direct distillation, that is, the light oil is evaporated until the oil becomes of such a consistency that it is suitable for road or other purposes for which it is intended. This residue, as it might be called, has certain characteristics by which it can be identified. Bituminous materials produced from California oil have the following characteristics: heavy gravity, low melting point, high ductility, practically no paraffin or sulphur, rather high fixed carbon, and a high solubility in naphtha. The nearest bitumens resembling the bitumens produced with California are the Mexican, but the California materials can be easily identified from the Mexican by the difference in fixed carbon and sulphur content. The Mexican asphalts always having a high fixed carbon and more sulphur.

BITUMENS DERIVED FROM TEXAS-OKLAHOMA OILS

The bitumens produced from the above fields come from what is commonly known as mid-continent fields, and have been used to a considerable extent in the production of materials suitable for paving and road building. These materials also have distinctive characteristics by which they can be definitely and easily identified. While some of the residuums produced from Texas oil are very similar in a great many characteristics to those produced from California oil, yet they are readily distinguished from the latter by having a lighter gravity and lower fixed carbon and are less susceptible to temperature changes.

On account of the tendency to mix crude oils, it is difficult to positively identify materials made from Texas oils unless it is also possible to have some knowledge that such mixing is going on and to carefully watch for the very small difference in characteristics. With the immense mileage of pipe lines practically connecting every oil field in the United States, and the active competition of the same oil companies in the different fields, there is an increased tendency to mix oil and this tends to make it more difficult to positively identify the different bitumens, and this is specially true in the mid-continent fields.

BITUMINOUS MATERIALS PRODUCED FROM ILLINOIS OILS.

The bitumens produced from the oil of this field are small in comparison to the volume of material produced from the other fields. For example, they have a specific gravity lower than that of the mid-continent oils and higher than the Pennsylvania field; they have a high per cent. of paraffin content and can be identified by these tests. Most of the bituminous materials produced from this field are compounded, being mixed with natural asphalt or bituminous compounds from some of the other fields.

BITUMENS PRODUCED FROM MEXICAN OILS

During the past few years, there has been a wide and rapidly increasing market for bituminous materials from this field, principally on account of their low cost. These bitumens vary in their characteristics to some extent, according to the crude oil from which they are made. These are two distinct Mexican oils from which they are made, one known as a light crude and the other the heavy. Bitumens made from the light crude are identified from those produced from the heavy by being less susceptible to changes in temperature, lower in ductility and lighter in gravity. On account of the difference in the method of manufacture of the various producing companies and the tendency to mix oils, positive identification is a difficult task to those outside of the industry.

BITUMENS PRODUCED FROM LAKES AND OTHER NATURAL SOURCES

There are a large number of materials commonly known as natural bitumens. Those from the island of Trinidad and from the northern part of Venezuela being most widely known in the road and paving industry. These materials have their peculiar characteristics different from any of the other bituminous materials. Those coming from the island of Trinidad being particularly characterized by the high but uniform per cent. of fine mineral matter, while those from the north of Venezuela are easily identified by their peculiar odor and relatively high per cent. of organic matter insoluble in carbon disulphide.

Of the solid native bitumens, Gilsonite is the best known and the one most largely used in the manufacture of road and paving materials. Most of the Gilsonite in this country is produced in the States of Utah and Colorado. Gilsonite has characteristics by which it is readily identified. It is a solid black mineral having a brownish concoidal fracture and a melting point from 285° to 300° F. It readily melts and homogeneously mixes with practically any bituminous oil. It has a comparatively low fixed carbon and is the purest native bitumen known.

Similar in a way but entirely different in their characteristics are Grahamite, Manjak and Elaterite. These bituminous materials have their own distinctive characteristics, the Grahamite being used more extensively than the others, but the products being produced from these materials are still more or less in the experimental stage and are of doubtful value, and at the present time are very little used in the production of materials for paving and road work.

While it is impossible to give or show in a limited paper the various characteristics of all the bituminous materials on the market at the present time, or to go into details of methods used for the identification of these bituminous materials and trace them back to their original source, and in a great many instances to the individual producer and individual brands, yet it may be again repeated in conclusion that each of these materials, and in fact each individual brand, has peculiar characteristics by which it can be identified by those in close and continuous touch with the industry. The tendency to combine and mix crude materials is making positive identification more difficult, but the progress in testing bituminous materials is also rapidly advancing so that in all probability those closely associated or working continuously on bituminous materials can continue to identify the source and in most cases even the producer.

* * *

## New Highway from Savannah to Seattle

We have trans-continental highways (on the map) from east to west and from north to south; even some crisscross from northeast to the southwest and now some one has gotten the idea of one from southeast to northwest. We are not advised of the exact route, but it is to start at Savannah, Georgia, and finally reach Seattle, presumably hitting Omaha somewhere along the way, inasmuch as a booster meeting is scheduled for that city some time this month.

# Tests for the Determination of the Cementing Value of Bitumens*

Mr. Philip P. Sharples, Manager, General Tarvia Department, Barrett Manufacturing Co., New York City

FOR a number of years, there have been attempts to introduce into the standard tests on bituminous materials used in road construction, a test for the cementing or binding value of asphalts and pitches. The subject is fraught with pitfalls of many kinds. All the questions relating to the temperature of testing, apply in an added degree to tests for cementing value, but we have in addition the question of what the bituminous material is to bind together, whether the tests are to be applied to the bitumen alone or to the bitumen as mixed with mineral aggregates and prepared for paving work.

Among the different experimenters, little attention seems to have been given to the difference between adhesive and cohesive tests. The cohesive tests are important in all kinds of paving work, but the adhesive tests become equally important in waterproofing work of all kinds, in pavement fillers and expansion-joint materials and in paving cements to be used either in cold-mix processes or by the penetration method.

In the case of coal-tar pitches and native asphalts, the subject is further complicated by the presence of very finely divided non-bituminous materials, called, in the one case, free carbon, and in the other, colloidal clay. These profoundly affect the viscosity and strength of the bitumen in a way that is difficult to eliminate or measure. Investigators have approached the problem from very different angles, and, though a number of methods have been brought forward, none thus far has been entirely satisfactory. Among those who have experimented are Lester Kirschbraun, Colonel E. E. Crompton, Major W. W. Crosby, A. W. Dow, J. S. Crandell, Prevost Hubbard, J. E. Myers, W. H. Fulweiler, O. Binder, the U. S. Geological Survey (Fuel Tests), and the French Admiralty.

In a general way, the methods used by Colonel Crompton, Hubbard, and Crandell were the same, while those of Kirschbraun, Crosby, and others followed other lines of investigation and treatment. These methods were, respectively, (1) making briquets of representative mixtures and then testing them for impact and compression, and (2) pulling apart films or pieces of neat bitumen and measuring the force required to rupture them.

Kirschbraun states that the binding value of a plastic binder is limited to the amount of tension it can sustain over a given distance. Or, it would be the product of mass by distance, or the area enclosed between a curve, plotted to represent tension and distance, and the X axis.

He says there must be a certain amount of "give" to a bituminous pavement, and therefore the bitumen used must be capable of elongating to some extent in order that sufficient plasticity is secured. There must be a certain amount of adhesion as well as cohesion, but exception may be taken to the state of Kirschbraun that cohesion is the more important of the two, and that adhesion enters but little into the discussion. It is lack of adhesiveness that lowers the binding value of many of the asphalts that are used as fillers for block pavements and for use by penetration processes.

It would be well to review the methods that have been used to date, of which anything has been published.

E. W. Parker ("Condition of the Coal-briqueting Industry in the United States," 1906) states that "out of the many attempts that have marked the incubating period of briqueting development, has grown the knowledge that coal-tar pitch, in the Eastern States, must be relied on to supply all or the greater part of the binding material. In the far West, the residuum produced from the refining of the heavy asphaltic base petroleums is successfully used. The results obtained in St. Louis in the United States Geological Survey fuel testing plant, show that either coal-tar pitch or asphalt pitch are the only really succesful binders."

Several tests are in use by makers and consumers of coal briquets to determine cohesion. In France, the briquets are tested as follows: 110 pounds of briquets are divided into 110 pieces of 1.1 pounds each, which are placed in a cylinder 36 inches in diameter and 39 inches in length. This cylinder revolves at a speed of 25 r. p. m. After being charged, it is revolved for two minutes, and the contents are thereupon sifted on a screen perforated with holes 1.12 inches square. The proportion which does not pass through the screen indicates the degree of cohesive force which, in the case of the French Admiralty tests, should reach 52%.

"Ordinarily, briquets may be considered sufficiently cohesive when the loss occasioned by dust and breakage involved in their use does not exceed 5%."

One test that has been noted for coal briquets, calls for the percentage of breakage and loss to be determined after the briquets are shoveled from a bin into a car. Another requires that test specimens be taken in the hands and handled and also be examined by the eye. Mr. O. Binder mixes sand and pitch and compresses the mixture in a cylindrical mold at a given unit pressure. Here again the comparison of results is made by hand and eye rather than by testing the cylinders for impact, compression, or tension.

The tests made at Norfolk by the U. S. Geological Survey for cohesion, were the *drop test* and the *tumbler test.* Briefly, these were as follows:

Fifty pounds of briquets were put in a box 24 inches square and 12 inches deep, with a drop bottom, 6½ feet above a cast-iron plate in the bottom of a second box. The briquets were suddenly dropped on the plate, then screened on a 1-inch-mesh wire screen. The pieces held on the screen were again dropped, the total number of droppings being five. At the last screening, the percentage that the weight of the pieces held bore to the original weight was called the "per cent. held by a one-inch screen" and the remainder was called the "per cent. through a one-inch screen." The *tumbler test* was very similar to the French Admiralty test given above. (See Bulletin 385, U. S. Geol. Survey.)

In an article in the Proceedings of the American Society for Testing Materials, vol. ix., 1909, Prevost Hubbard gives the results of his experiments on the effect of free carbon in tars from the standpoint of road treatment. Taking four samples of tars of very different consistencies, he brought them to the same consistency by mechanically mixing with them free carbon in the shape of lamp black. In one of his experiments, he made a number of briquets of sand and tar cast in a cylindrical mold, using 6% of tar in some and 10% of tar in others. These were then tested for compression and the results were tabulated. Since these tests were made for the purpose of determining the effect of free carbon in tars, they did not include tests on asphalts. Furthermore, if the free carbon were removed, the samples used would necessarily be of very different consistency, and therefore what was actually compared was not tars of the same consistency but tars of different consistency brought to the same consistency by the mechanical addition of free carbon.

Colonel Crompton has written into his specifications prepared for the Road Board of England, what he terms "Percussion Tests," which are really tests of the binding or cementing value of the wearing course of bituminous pavements. "From the first batch, and from every tenth succeeding batch according to the magnitude of the work, test cylinders shall be prepared as follows and set aside for testing and record purposes. . . . Fifty grams of the hot mixture from a batch at the completion of the mixing should be filled into a mold cylinder (1¼ inches diameter x 2 inches deep). A plunger is inserted and driven down by a few blows of a mallet and finally compressed by a screw jack or bench vise. When cold, the compressed cylindrical sample is to be forced out and marked for identification. . . . A pressure of 500 lbs. must not shorten the cylinders more than 5% at 77° F., or 10% at 100° F., and in neither case must cracks show themselves on the external cylindrical surface.

"The cylinders must stand not less than 10 blows delivered by the ball end of a hammer rounded to 1 cm. radius, the head of which weighs 2 pounds, falling through a distance of 8 inches. The number of blows will be counted until the first crack appears."

It will be noted in the foregoing that no definite pressure in molding the briquets is specified, nor is there a temperature to which they shall be brought at the time of breaking. It will always be found that slight variations in the methods of making the tests cause considerable variation in the results, so that it

*Presented before Section D of the American Association for the Advancement of Science at the Columbus Meeting, December 29, 1915.

is necessary to take every precaution to duplicate the conditions under which each of the tests is made.

Following along the lines outlined above, John S. Crandell, in 1913-14-15, made and tested a large number of briquets. Instead of confining the tests to one material, 18 different bituminous materials were tested. They were mixed separately with varying proportions of sand and stone. The proportion of bitumen increased by degrees from 6% to 15% by volume of the entire mass. The briquets were all made by the same person, under uniform conditions, with uniform care. They were tested for impact in the Page impact machine, at 5° C., after ageing a uniform time. All reasonable precautions were taken to insure uniformity throughout. Two briquets of each mix were made and tested. In spite of the care exercised in heating, molding, cooling, and testing, surprisingly erratic results were obtained in some cases, although the general idea gained from a study of the curves made by plotting the percentage of bitumen as abscissæ, and the number of blows required to fracture the specimens as ordinates, showed that the mixture of maximum strength was that which contained about 11% of bitumen. While a greater amount of bitumen gave a greater number of blows in a number of instances, yet the increase over those containing about 11% bitumen was so small that the conclusion to be drawn was that the economical limit was at the lower percentage.

Major W. W. Crosby endeavored to work out a satisfactory cohesion test. He used two circular glass discs, each about ¼ inch thick, 66 mm. in diameter, area 3,491 sq. mm., with a groove in the circumferential edge about $^3/_{16}$ inch deep. Three grams of bitumen were placed on the lower disc, which was then covered with the other. They were then pulled apart horizontally, and the pull was recorded by a spring balance. These results were not wholly satisfactory, and the method was improved by warming the discs and the bitumen between them, and then pressing the discs together until they were thoroughly coated. They were then left over night in a temperature of 25° C. The results were very much better. Some of the asphalts, however, refused to cover the discs, and hence did not give as good results as were hoped for. This test would necessarily be successful only when the adhesion exceeded the cohesion. If the cohesion exceeds the adhesion, the material pulls away from the discs.

L. Kirschbraun devised an apparatus that records the stress applied over a distance. The form of the briquet adapted was that commonly known as the Dow molds which are used for making ductility tests. A dynamometer recorded the stress and readings were taken at each 5 mm. elongation. Curves are then plotted with centimeters elongation for abscissæ, and kilograms for ordinates. The conclusions reached are interesting. It was found that the cementing value increases with hardness up to a certain limit, at which the material becomes too brittle for service on the streets. Fluxing beyond a certain point reduces the ability to elongate, and also reduces the binding value. It is necessary to consider not only the binding value alone, but also the ability of the binder to elongate, in order to prescribe those which have the property of holding together mineral aggregates without undue tendency to cracking. Pavements under heavy traffic require stronger and more cementitious binders with less need of these binders to elongate. It is claimed that the method described furnishes a means of determining the value of the various fluxes, and their suitability in asphalt combinations.

A test known as "Toughness Test" has been used by the New York State Commission of Highways. The test, which has been devised by J. E. Myers, consists of making cylinders of neat bitumen and testing them for impact. The specimens are brought to 0° C. In making the test, the first drop of the hammer is from a height of five centimeters, and for each succeeding blow the height of the drop is increased one centimeter. The height from which the hammer falls when rupture occurs is given as the toughness of the material.

Clifford Richardson and C. N. Forrest (Proceedings American Society for Testing Materials, vol. ix., 1909) give the following test for cementing value: "Petroleum oils have very feeble if any cementing value. Materials requiring a high temperature to flow freely will not adhere to cold road metal. To determine these properties, the material under examination is heated to the temperature at which it will be used in practical work, and a portion is then allowed to flow over the surface of a slab of marble or glass, 4 inches wide, 5 inches long, and 1 inch thick. After standing 24 hours at 77° F., the film upon the slab must be decidedly sticky when tested with the fingers, and must adhere so that it cannot be pulled off." The method at its best is but a crude one.

C. B. Osborne, in "Good Roads," June 7, 1913, describes a machine for testing adhesiveness. The machine consists of a free ring rotating around a cylindrical mandrel. The bitumen to be tested is placed between the ring and the mandrel and the time required to rotate the ring is taken. The machine does not, therefore, test adhesiveness but a modified resistance to flow which depends on its value in comparison with other viscosity tests in that the temperature of testing, 77° F., is the practical working temperature of the material.

The methods that have been employed show wide variety in scientific accuracy. Those that give the most promise are the methods on neat bitumens employed by Kirschbraun and the briquet methods of Crandell. The field for future research would seem to be in combining these two, using perhaps also the method employed by Myers. It is only by the collection of a large amount of data by different methods on the same series of samples that progress can be made.

The problem of the tars is even more difficult. Hubbard has indicated some of the difficulties of the problem and pointed the way for future research. Much, however, remains to be done in this difficult field. Research in this field would necessarily be accompanied by the devising of means of eliminating the free carbon in the comparisons without otherwise changing the bitumens. Up to the present time, this has not been successfully done.

A study of the briquet methods of Crandell would seem to show the necessity of devising better methods of choosing and sizing the mineral aggregate and of compressing the briquets in order to make them of uniform compression.

The results of devising a successful method cannot help being far reaching. A direct method would be given for the comparison of different kinds of bitumens in a practical way that would of great value both to the manufacturer and user of bitumens.

My thanks are due to my colleague, John S. Crandell, for his valued assistance in preparing this paper.

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* * *

Beloit, the county seat of Mitchell County, Kansas, paved more than nineteen blocks with brick and asphalt last season, being the first paving work ever done in the town. Contracts for five blocks of street paving and several blocks of alley paving have been let for next year.

* * *

By the narrow margin of 208 votes the project for constructing twenty-one miles of improved roads between Kendallville and Ligonier, part of the Lincoln Highway in Noble County, Indiana, was defeated at a special election held in four townships last month. Over three thousand votes were cast. The road was to have been constructed of concrete.

# Macadam Road Construction in Michigan

By G. C. Dillman, District Engineer, State Highway Department

WITH the gradual increase of State reward road building in Michigan, that of macadam construction has played a very important part the last few years. In the northern peninsula, there is a wide range of stone, from the limestones to the best of trap rock and granites. In the southern peninsula, limestone is mostly used, but there is a small mileage of field stone macadam. The limestone macadam roads are limited to localities within economic freight haul of stone quarries or on lake ports. Hence very few roads of this class are being built in the central part of the State.

Saginaw County leads the lower peninsula with 158½ miles of macadam roads built to January 1, 1916, while Delta County leads the upper peninsula with 61 miles. The total mileage for the State from year to year since 1905, when the State Highway Department was organized, is as follows:



Macadam Construction in Berrien County

| | |
|---|---|
| Fiscal year ending June 30, 1906..... | 6.276 miles |
| Fiscal year ending June 30, 1907..... | 52.912 miles |
| Fiscal year ending June 30, 1908..... | 153.266 miles |
| Fiscal year ending June 30, 1909..... | 164.592 miles |
| Fiscal year ending June 30, 1910..... | 236.529 miles |
| Fiscal year ending June 30, 1911..... | 306.008 miles |
| Fiscal year ending June 30, 1912..... | 406.133 miles |
| Fiscal year ending June 30, 1913..... | 518.111 miles |
| Fiscal year ending June 30, 1914..... | 647.379 miles |
| Fiscal year ending June 30, 1915..... | 789.820 miles |
| To January 1, 1916..... | 931.3 miles |

From these figures, it will be readily seen that this class of road is gaining not only in mileage but the increase in mileage each year is increasing over that of the preceding year.

Due to the frequent rains, the past season has been one exceptionally bad for macadam work, yet the mileage has increased more than in any preceding year.

So much is being said and written of late about the construction of the ordinary type of macadam road that I will take up only the subject of binders. In this type of road the wear coming upon it must be taken care of almost wholly by the stone that constitutes the body of the road surface. This stone, constituting about 70% of the volume of the road surface, when finally compacted must be held in place by the stone screenings or binder, aided somewhat by the mechanical locking of the larger stones.

For the first course of stone, the binder should be that part of the crusher product passing through the three-quarter-inch section of the crusher screen and containing not over 20% of dust. Dust will be considered as that part of the product passing through a screen having twelve mesh to the inch. Where the harder rocks are used, such as trap rock, granite, and field cobbles, it is impossible to make too much dust.

The binder for the top course of limestone macadam should be that part of the crusher product ranging in size from three quarters of an inch down, from which all the dust has been removed. In my opinion, the reason for eliminating this dust is that the 30% of voids will be filled with small broken stone having not only ability to wedge the larger stones in place, but be able to stand its part of the wear which must necessarily come upon it.

A road bonded with such chips will require much more rolling but sufficient dust will be formed to completely fill the smallest voids.

The one exception to bonding a macadam road with clean chips is the cost of building macadam on a clay foundation when the soil contains much water. In this instance, use a binder containing about 50% dust to completely close up the voids before much rolling is done. Wet clay has a tendency



Macadam Construction in Dickinson County

to come up through the stone when rolling, thus bridging the spaces between them. This bridge will ultimately break down from either pressure or moisture or both, and as a result raveling starts. But macadam construction on a wet clay foundation should be discouraged since good results cannot be obtained with the best of workmanship.

There are many forces tending to disintegrate a macadam surface, chief among them being the tendency of a rapidly moving wheel to suck any loose material out of place and the horse's calk acting as a chisel, prying out the binding material between the stones. Then the dry weather is a natural force having much to do with a macadam surface raveling.

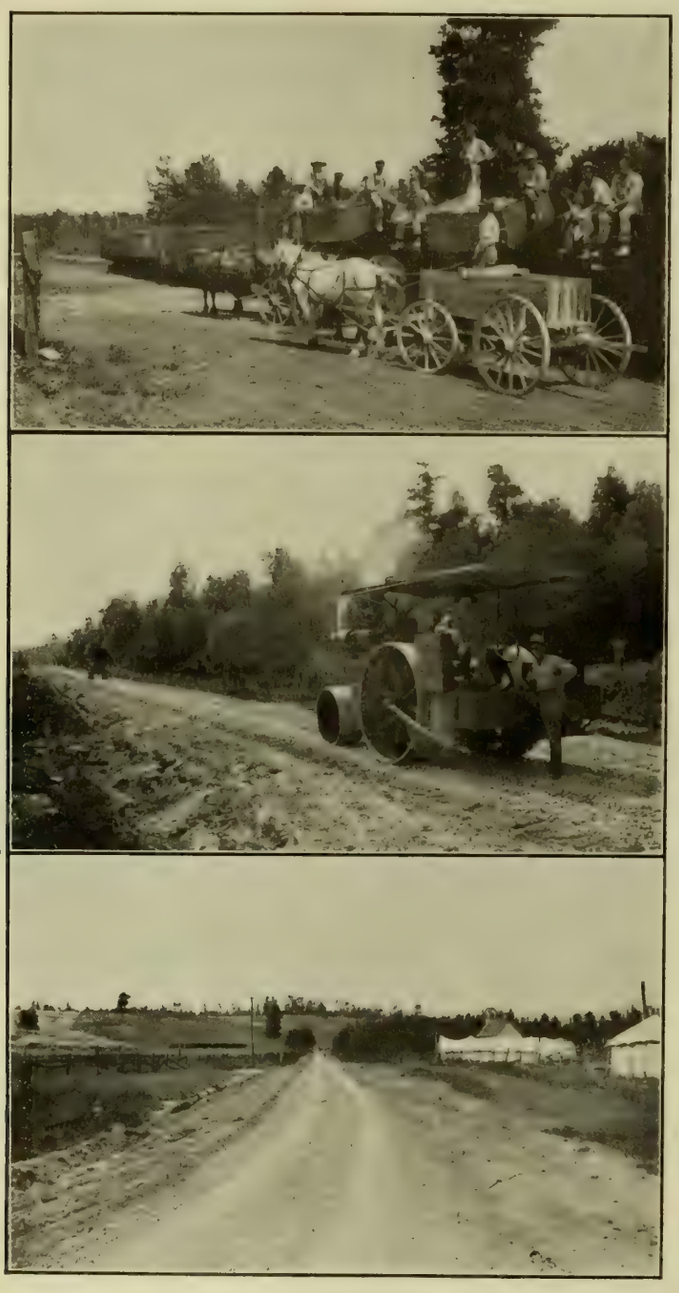
When binding either course of stone with screenings containing a large per cent. of dust, a mat may be formed on the surface of the stone before the voids are completely filled. This may occur even though the screenings are rolled in when dry, but with clean chips very little difficulty will be encountered.

To stand heavy traffic during a prolonged drouth, a water-bound macadam road must have the voids entirely filled with screenings, and to secure this condition the screenings should be rolled in when dry. Even on a well-compacted road the stresses imposed upon it by our varying climatic conditions

are to be reckoned with. Yet, should there be voids, the risk of failure increases.

A macadam road will ravel very little with proper bonding, but this is one matter requiring skill and judgment. The action of wind and rain is not to be overlooked, since an appreciable amount of the wearing surface itself is carried away by these natural agencies. The dust worn off by traffic will be sufficient to bind these coarser particles together. So it is evident that the binder itself should be of such nature that it will be capable of resisting these forces as far as possible.

Dry weather is the great natural force tending to cause a macadam surface to ravel. This is especially true of cobble or trap rock macadam. A few counties in this State have had excellent results by applying a skin coat of from one-half inch



Macadam Construction in Kalkaska County

to three-quarters inch of loamy gravel to this type of macadam. This supplies enough binder to replace that removed by traffic and acts as a cushion, thus preventing a certain amount of wear on the road surface.

Until two years ago, but few Michigan waterbound macadam roads had been treated to a bituminous carpet coat. The treatments given these roads were in the most part experiments, and the results in many cases were anything but satisfactory. Some of the products being tried out were not suitable for what they were being used for, and many times they were not properly handled.

Since then, however, some of these so-called "surface treatments" have been lost sight of. New ones of much value have come upon the market and with them more discretion is being used in their application. So to-day, Michigan has many miles of macadam roads so treated and when a good material is properly used it has been found worth while.

Should there be any ruts or holes in a macadam surface, repair them, since any attempt to eliminate them by extra application of the carpeting medium will necessarily result in a non-uniform carpet.

In some instances, roads have been treated to a carpet coat almost immediately after completion. This always results in a failure due to the excess chips and dust preventing the bituminous material from adhering to the stone comprising the wearing surface. The road should be allowed to go through one season giving the chips a chance to be worn down.

Then, when the road is dry, sweep it free from all dirt, dust, and other loose material, leaving the edges of the coarse surface stone exposed. The road should be closed to all



Macadam Construction in Dickinson County

traffic, but in cases where the detour is bad and the width of the metal is great enough, as on our trunk line roads, one-half the width of the metal may be treated at one time. One-quarter to one-third of a gallon per square yard of the heated bituminous material should be applied, preferably by pressure distribution.

Clean limestone or trap rock screenings should then be immediately applied, care being taken to spread them uniformly to just cover the carpet. This will require about a one-quarter-inch course of chips. On some roads sharp sand is used, but this, I believe, does not form as firm a surface.

A bituminous carpet is not intended for and will not serve to correct faulty construction in the macadam itself. Yet, if there are some weak places in the bond, it may prevent ultimate failure.

The writer has in mind a 16-foot macadam road built in the spring of 1915. The road was apparently well built, but in about two months after completion a few places began to ravel. These places were given a surface treatment of about one-third of a gallon per square yard. Although the tourist automobile traffic was heavy during the summer, the raveling was completely stopped and the road is all in excellent condition to-day.

* * *

## North Carolina

THE Wilmington-Fayetteville Highway Association, having for its purpose the promotion and encouragement of the building of a link of improved roadway from Wilmington through the counties of Pender, Duplin, and Sampson, connecting with the National Highway north and south at Fayetteville, was formed at Burgaw, N. C., as the climax of an enthusiastic mass meeting of citizens of all the counties interested, initiated primarily by the Rotary Club, of Wilmington, which added still another laurel to its crown of constructive achievement in the magnificent success of the gathering, ably seconded by the hosts of the occasion, the good people of Burgaw and surrounding country.

The meeting was attended by approximately 250 members of the Rotary Club of Wilmington and their friends, who journeyed thither over the section of the proposed highway between this city and Burgaw in fifty-odd booster automobiles which carried appropriate banners advertising the purpose and place of the meeting and filled with enthusiastic good roads advocates and their friends, including not a few ladies, these being joined at the meeting place by delegations from the other counties and hundreds of Pender County people, who proved themselves most gracious hosts and hostesses in a most enthusiastic welcome and in an elegant barbecue served on the lawn of the court house in which the meeting was held.

Able and inspiring addresses were delivered by representatives from every section, and it is safe to say that during the meeting seed were sown from which good roads advocates in this coastal section of the State may reasonably expect to reap an hundredfold. Action was the keynote of the meeting; and, engineered by those human dynamos, commonly known as Rotarians, nothing was left undone to score of the meeting a splendid success. A more perfect day for the meeting could not have been imagined; in the long line of automobiles there was not the semblance of a serious mishap, and what the good folks of Burgaw did for the visitors left nothing to be desired, even in the smallest way. The several committees in charge, both in Wilmington and at Burgaw, did their work so creditably, so perfectly, and with such precision, that to single out any one or more for special mention would be an injustice to others who did equally as well.

For some months there has been more or less agitation of the question of connecting Wilmington with the capital to Capital Highway at Fayetteville, through the counties in question, but there had been no concert of action on the part of the counties, and while all had done something, and are still accomplishing much in road improvement, there had been no special effort to work to a definite end. The Rotary Club conceived the idea of crystallizing the effort, they had only to pass the word to the enterprising sister counties, and lo, the Burgaw meeting!

It was in Wilmington that the association was formed for the purpose of getting concerted action from the counties; representative men from each freely offered membership and the Wilmington-to-Fayetteville Highway Association sprang into existence with the following officers:

President, W. M. Hand, of Burgaw; Vice President, A. B. Skelding, of Wilmington; Secretary and Treasurer, J. T. Bland, Jr., of Burgaw; Executive Committee: W. L. Byrd, of Duplin County; George E. Butler, of Sampson; W. D. MacMillan, of New Hanover; Thomas H. Sutton, of Cumberland; and T. J. Armstrong, of Pender.

Attention was called to the fact that the executive commitee consists of a member from each county interested. The nominating committee consists of a member from each county interested. The nominating committee was composed of Dr. George K. Patterson and A. B. Skelding, of New Hanover; W. L. Byrd and G. R. Ward, of Duplin; W. M. Hand and T. J. Armstrong, of Pender; J. R. Peterson and L. A. Bethune, of Sampson; J. H. Sutton and R. M. Jackson, of Cumberland.

*New Hanover County.* Under the supervision of Road Superintendent Burnett, the road forces have made splendid progress, and, as a result of their efforts, several stretches of new roads, some of which had been started during 1914, have been completed; notably the following:

The Greenville road (sand-clay), 40 feet wide, for a distance of three miles, connecting Masonboro and Seagate, and opening up a very rich section of our county.

The new road, approaching Northeast River bridge from Castle Hayne, a distance of 1.7 miles, was built of clay-gravel taken from the new county quarry, located on Prince George's Creek. This material has splendid binding qualities and makes an excellent road. It is the opinion that the county made no mistake in acquiring this property, as there appears to be large deposits of rock, which is well suited for road construction.

The lower end of the Scott's Hill road, 1.4 miles, was completely rebuilt during the year, having been resurfaced and put in first-class condition.

Work of cutting right of way and grading Fort Fisher highway, which had been previously planned, and was well under way, has been pushed to completion. This stretch of road connects with the "loop" near the seven-mile post and extends to Fort Fisher Sea Beach, a distance of approximately eleven miles. This road has an average width of 30 feet, and the road forces deserve special mention for the good work done.

Under special contract with Messrs. C. R. Humphreys & Co., the county is now having this road macadamized with shell rock a width of 12 feet and a depth of eight inches. The contractors have completed three and one-half miles of this work. The contract under which this work is being done provides that the county pay one-half cost, and the Hanover Transit Company, Wilmington Beach Corporation and the Kure Land and Development Company jointly pay the other half up to a point near the Carolina Beach boulevard. The beach interests have agreed, at their own expense, to carry this road on for a distance of approximately two and one-half miles to a point touching the property of the Kure Land and Development Company.

Satisfactory progress is being made on the Acorn Branch road, and same should be completed within the next two months. Approximately three miles of this road has been graded, and the forces are now only a short distance from Acorn Branch. When this work is completed it is respectfully recommended that a portion of the road between Acorn Branch and the Castle Hayne road, which is very narrow, be widened.

The State Highway Commission is laying special emphasis upon the importance of proper maintenance and upkeep of roads after they are built, and in this connection, has made highly favorable reference to the phase of the work in New Hanover County. The roads of the county are in splendid shape and with a small repair force constantly at work, there is no reason why they should not be maintained in their present good condition. *Mitchell County,* the county in which Mount Mitchell the highest in the East is situated, reports that with a grade of 4 per cent. to 5 per cent. we can travel in comfort in many directions and where it was impossible before to go with a machine. The time is coming when we can travel in almost every direction easily.

From Bakersville, out through the Red Hill section, and up Big Rock Creek, the road leading up to Glenn Ayer, up Cane Creek, and to Toecane, the roads have all been put in fairly good shape, under the supervision of Tom English, the roads in Grassy Creek Township are among the best in the county, well built, with easy grades. Where before horses sweated and pulled they now rest pulling. And where a lot of lumber stalled in the mud now we see teams trotting at their task.

*Lee County,* one of the most progressive good roads counties in the State, is well along with the completion of her splendid system of fine sandy-clay roads. This county has issued a total of two hundred thousand dollars for road work and has had a successful administration of the funds and the work. When complete this county will have about one hundred and fifty miles of as good roads as any in the State.

The work in Sampson County is progressing very nicely. There are several roads being built by hired labor, and the convicts are building one from Roseboro to Clinton. The people of this county are contemplating a highway from Autryville via Roseboro to Clinton, thence to Wilmington.

*Surry County.* The following townships in Surry County have been doing good work: Siloam Township begun construction work in October, and have graded about 9 miles of 20 ft. road, and ½ mile of 40 ft. road, which serves as a street through the village of Siloam. This work is being done by contract at 21 cents per cubic yard, and is very satisfactory. No top soil has been put on yet. This will be done in the spring. Shoals Township began their construction work in November, and have graded two miles of heavy earth work. This work is being done satisfactorily by contract at 21 cents, the road being twenty feet wide. No top soil has been put on as yet, this will be put on in the spring.

*Chatham County.* In Chatham County, the Center township road force of 30 mules, that have been grading south from Pittsboro. When this is completed and the road from Siler moved camp about three miles west of Pittsboro. The road from the Hickory Mount Township line will be graded to Pittsboro. When this is completed and the road from Silder City to Hickory Mount line is finished there will still remain a gap of 8 miles of unimproved road. Nearly two miles have been graded north of Pittsboro. None of the roads being graded will be surfaced before spring. In Haw River Town-

ship the road force have nearly finished grading the road between the Lockville and Haywood bridges.

*Beaufort County.* Washington Township in this county has just completed a successful campaign by voting fifty thousand dollars for road work in the township. This is the first bond issue successfully negotiated so far east in the State, and gives promise of other good news from this section. A. M. Dumay and J. T. Leach are among the officials of this Township.

*Person County.* Roxboro Township, Person County, have issued bonds to the amount of $75,000, to improve their roads, and the work is now going on. About two miles have been completed, and several more miles graded. Much of the roads will have to be relocated to avoid the present terrible grades. The first section tackled was over the mountain at the southern end of the town, and across a deep valley. They now have a road around the peak with a maximum grade of 4%, not much of it being that high. The old roadbed has been followed. There has been some good work done in the giving of right-of-way, which has been the means of giving a better route to Oxford.

Three new bridges are being handled by the State Highway Commission. One is Ashe County under contract by the Joliet Bridge Co., of Joliet, Ill., and one in Edgecombe County that is being built by the State Highway Commission for the county; and one in Franklin County to be let to contract February the fourth. The first named bridge is of steel and the last two are of re-inforced concrete.

* * *

## Maine

WHAT the State Highway Commission has accomplished during the past two years the subject of an address by Paul D. Sargent, Chief Engineer of the Maine Highway Commission at the annual meeting of the Maine Automobile Association held at Portland, Maine, the evening of December 20, 1915.

In part Mr. Sargent said:

"The first thing of importance accomplished by the State Highway Commission during its two years and a half existence was the laying out of a comprehensive system of State highways. Under the provisions of the State highway law the commission tentatively designated the system and then held public hearings at some eight or ten different points in the State for the discussion of the system as tentatively laid out. The system as finally adopted, but which may yet be changed in a few of its parts, comprises 1,300 miles of road. This is five per cent. of the entire road mileage of the State.

Statistics carefully compiled show that in the cities and towns on this 1,300 miles are found 73 per cent. of the entire population of the State and 73 per cent. of the total valuation of the State. Aside from the fact that the highway commission has laid out a system so small in mileage, which accommodates such a very large proportion of our people, it should be borne in mind that the roads comprised in this system are at the same time the ones most frequently used by the summer tourists; thus it seems as though the commission had met a double need in the lay-out of this system and have certainly performed this part of their work in such a way that it brings the greatest good to the greatest number of people.

One provision of the law, under which the commission began operations was that whenever State highway construction was undertaken, the work must be continued in one location until a continuous section of seven miles on improved road resulted. With this provision in mind the commission attempted, during 1914, the construction of practically a seven mile section of State highway in each county. Altogether 132 miles of construction was provided for, but during the year work completed was equivalent to 100 miles of finished road. The expenditures on this work in 1914 were $763,000.00.

In 1914 the customary amount of State aid work was done among the various towns; 148 miles of road were built in 488 towns and the expenditure was $609,700.00. About nine miles of road were built under apportionments of automobile registration money which had been made by the governor and council prior to the passage of the new State highway law and in round numbers $20,000.00 was expended on this work.

Under special resolves of the Legislature for roads and bridges, $120,000.00 more was expended; on maintenance work the expenditure was $86,500.00, so that during the year 1914 a total of $1,600,000.00 was expended under the direction of the State Highway Commission on new construction and maintenance work.

*Completed Contracts*

During the year 1915 all of the contracts let in 1914 have been completed. Some new work has been done in every county and altogether we have ninety miles of State highway work to the credit of the highway commission for the year. The total expenditure on this work has been $540,000.00.

State aid construction for the year 1915 is estimated at 140 miles of completed road and we estimate the cost will be $605,000.00. Under special resolves for roads and bridges, $81,000.00 has been expended. On the maintenance of State and State aid highways the expenditures have been approximately $100,000.00, so that during 1915 $1,325,000.00 has been the approximate expenditure of the State Highway Department for the construction and maintenance of improved road.

If you have followed the above analysis of the expenditures of the State Highway Commission, you will see that during the two years 1914-1915 the gross expenditures under the auspices of the State Highway Commission have been only a little less than $3,000,000.00.

The highway commission has received not a little gratuitous advice as to the proper type of road to be constructed on State highways. The commission has endeavored, however, within extremely reasonable limits, to combine materials locally available into the type of surface which seemed best fitted to meet traffic conditions. This has resulted in the construction of Portland Cement Concrete, bituminous macadam, water-bound macadam and gravel surfaces, by far the larger mileage constructed having been surfaced with gravel. Some of our gravel roads have been surface-treated; all the water-bound macadam which we have built and a considerable mileage of the gravel road will be treated next season, both for the purpose of preserving the surface and laying the dust.

In the matter of maintenance of State highways, as fast as a section has been completed we have immediately put it under patrol maintenance; the sections run from five to seven miles in length and the patrolman devotes his entire time to the care of the road. He furnishes a horse, a light truck wagon, a split log drag, and the necessary small tools. At the close of the present season the commission had in their employ 25 patrolmen. Generally speaking the work of these patrolmen has been very satisfactory and they have been able to maintain their respective sections in good passable condition at all times.

While speaking of maintenance I might state that under a law passed last Winter, known as the patrol maintenance law, the commission hopes to have a patrolman in each mile of State highway during the next season, whether it has been improved or not. It is hoped, and the commission believes, that under this system our main thoroughfares will be in much more agreeable condition for travel during the summer months at least than they have been heretofore.

I understand the object of this meeting is to discuss the matter of more money for State highways and the possible means of meeting that need. In this connection it is interesting to note that since the inauguration of State aid the State and towns have made a joint expenditure of practically $5,000,000. If this money had been expended in the construction of continuous stretches of State highway, the same as the bond issue money has been expended, we would now have quite a respectable system of State highways completed.

* * *

The fifth annual meeting of the Indiana Crushed Stone Association was held at Indianapolis, January 13, 1916, and a report of the officers showed that the members of the Association had enjoyed a flourishing business during the past year. At the annual election the following officers were selected for the ensuing year: E. B. Taylor, president; E. T. Milligan, vice president; V. G. Pogue, treasurer; F. M. Connell, secretary, and the board of directors consists of E. B. Taylor, E. T. Milligan, V. G. Pogue, L. H. Hawblitz, and O. H. Binns.

# Road Pickings, No. 13

By William Sport

## In which Dennis Talks about Short Memories and Other Things




MY DEAR CASEY:

Bedad, an' you 're afther askin' me whither Oi 'm a-comin' over to Pittsburgh to th' road show! You 've got a short mimory, Casey, loike siveral convintion 'prromoters Oi 've heard av recently. What was it thot Oi was afther tellin' you not wan year ago, thot Oi 'd go to wan national convintion iv'ry year an' only wan. Yis, sor, an' it 's Dinnis thot 's goin' to sthick to thot risolution.

Thin, too, Casey, Oi can't say fer sure, but a lot of my materrial frrinds have been afther writin' me fer to meet thim at th' cimint show an' thot they wouldn't be at Pittsburgh at all at all.

No, Casey, not only th' cimint men but a lot av asfalt fellers an' some av th' larrgest manufacturers av road-buildin' machinery an' motor thrucks.

They 're afther tellin' me thot so minny av th' outsiders are a-comin' to th' show thot they had to go an' hire th' Firrst Rigimint Arrmory to git thim all in. Oi don't remimber where th' arrmory is, but Oi 'm hopin' thot it ain't near th' sthock yarrds; Norah sez she can schmell thim iv'ry toime Oi put on thot overcoat Oi wore to th' road show last year.

So, Casey, Oi figger thot Oi 'll be near brreakin' my risolution even by takin' in th' cimint show if its a-goin' to be a regular road show this year loike they sez it is excipt th' name.

Av course, maybe Oi won't git to see enny brrick roads but Oi 'll see half av thim ennyhow—iv'rything but th' brricks, an' Oi 'm not shure but Oi 'll see some av thim too; th' Colyseum wouldn't seem natural if some wan wasn't a-throwin' thim arround, espicially durin' th' National Convintion year.




"They could build a pretty good speedway by this toime."

An' thot reminds, Casey, Oi suppose both av th' parrties will be afther puttin' some good roads planks in their platforrms agin this year an' git up schemes fer handin' out wan dollar an' noinety-sivin cents a mile frrom th' Fideral treasury to all av th' township highwaymen in iv'ry congrissional disthrict.

With all av thim good roads planks left over frrom th' old platforrms thot have niver been used, they could build a pretty good spheedway by this toime, Oi 'm thinkin'. They might use thim to build another wan av thim Chivvy Chase bullyvards out to th' Prisident's golf club. Thot would be a foine an' lastin' monumint to Dimmicratic thrift an' economy; they could use th' rist av th' money fer some more million-dollar postoffices an' harbors fer ocean goin' liners in Lake Texas.

No, Casey, Oi haven't turned Republican yet on ennything excipt roads an' National defince, an' on thim Oi ain't a Republican; Oi 'm more loike a mugwump.

But ennyhow, Casey, you ask if there 's goin' to be enny road worrk a-goin' on this year, an' Oi sez, "Yis," Fideral aid or no Fideral aid.

Y' remimber afther a-comin' back frrom Milwaukee a year ago, as how Oi sez thot it wasn't Murphy County, Pinnsyl-




"Some av thim had betther be afther learnin' how to dodge harrd brricks."

vania, thot was a-goin' to perrmit a little Wisconsin county full av Dutchmin to beat thim a-buildin' harrd roads?

Well, it 's no less than sivin thousand other counties thot have been afther sayin' the same thing, an' s' hilp me if they arn't holdin' sphicial elictions fer bond issues in more thin half av th' counties av all th' Cinthral Sthates frrom Ohio to Nebrasky.

Yis, sor, there 's sivinty-foive av thim in th' grreat an' muddy Sthate av Illinois alone, all fer harrd roads an' divil a wan av thim fer less than wan million dollars.




"An' he's niver scen betther roads than th' wans his granddad used to build a workin' out his poll tax."

An' thin over in th' nixt Sthate it 's th' same thing they 're doin' only they 're afther callin' grravel roads harrd roads in thot Sthate. Oi suppose they can call thim whativer they loike, but it's not Dinnis that would be afther runnin' fer road commissioner afther th' grravel roads is all worn out an' th' people are sthill a-payin' taxes fer th' bonds.

Th' people of th' Sthate have always said, "We ain't ready fer harrd roads yet," an' maybe they 're roight but some av thim had betther be afther learnin' how to dodge harrd bricks a little later on.

An' sphakin' av harrd roads, Casey, did yez iver attind a meetin' av taxpayers in a mud road county whin they was

a-worrkin' up sintymint fer a bond issue or some more taxes for harrd roads.?

Av course, they always have a lot av material prromoters an' a couple of gingerbeers an' Fourth av July orryters arround with movin' pictures av beautiful smooth bullyvards in all parrts av th' counthry.

But thin when they have things all a-goin' foine an' iv'ry wan av th' farrmers all ready to go home an' git out th' owld sock frrom between th' matthresses, some wan av th' leadin' local cityzens always gits th' idea thot he ought to be polite an' rispond by tellin' something av th' roads in his county.

He sez, "Ladies an' Gintlemen; friends an' fellow cityzens, did yez iver sthop to think thot roight here in our own county, yis, roight in this township, is th' verry bist dirt fer buildin' roads n th' whole Counited Sthates?"

Thin he always sez he 's lived there fer nigh onter forrty years an' he 's niver seen betther roads than th' wans his granddad used to build a-worrkin' out his poll tax, an' if th' people would only dispinse with all av th' ingineers with their hifalutin' ideas an' use local material instid av imporrtin' a lot av asfalt an' cimint an' tar an' brricks, they would be afther savin' millions av dollars iv'ry year.

Av course, Casey, it 's only in th' summer toime thot you hear enny av thim spheeches. In thim counties they nivir can hold enny good roads meetin's in winther excipt by tellyphone.

An' minny people have short mimories, as Oi was afther tellin' you.

* * *

## Asheville-Charlotte Highway, North Carolina

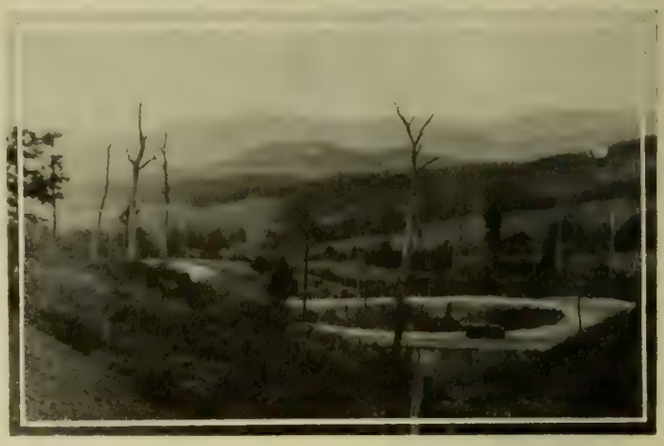
A CELEBRATION of state-wide importance was the official opening of the Asheville-Charlotte Highway at Bear Wallow. This highway is the first in North Carolina on which State convicts have been worked. The seven and one-half mile link of this highway in Henderson County across Hickory Nut Gap Mountain is considered an unusual feat in road building, as up to 1913 the matter of building a road across this mountain had been considered an impossibility because of the expense necessary to cross this steep rugged mountain, much of which had to be done through solid rock.

The principal speaker at this celebration was Governor Locke Craig, who stated that in maintenance of the convicts it had probably cost the State about $50,000, most of which, however, would have been expended for their maintenance elsewhere, but even at this figure he considered the completed road



Old and new methods of transportation at forks of road on Asheville-Charlotte Highway

was worth ten times that amount to the section which it traversed, western North Carolina and the State as a whole. Governor Craig congratulated the people of the community and western North Carolina on what has been done for the entire State and for the community beyond the State, for the people of other communities of other States in the completion of this splendid highway over which they come into these wonderful mountains of western North Carolina to enjoy the splendid climate, good water and hospitality of our people. He said that this road or highway had been up at Raleigh in nearly every meeting of every kind that had been held there since he had been elected Governor, and referred to Senator Zeb. Weaver introducing the bill providing for the convicts on this road. He further said: "The building of roads by State convicts is a policy that has not heretofore been in operation or adopted by the State. Superintendent Mann, of the State prison, has been in favor of working the men on the roads and keeping them here to finish the road. Without the convicts this road could never have been built. The people ought to have the



Scene on Asheville-Charlotte Highway

road, but it would never have been possible for the people to build it without help from the State. The only other road in the State where State convicts have been building a road is over in Madison County, but they were not as clearly entitled to a road built by the State convicts as were the people here in Hickory Nut Gap, the completion of which gives them a good road into Asheville, and Hendersonville and Rutherfordton, and the people of other sections of the State a good road to get into these beautiful mountains; also a road across the mountain at the Swannanoa tunnel to Old Fort, which will give the western section four great highways from the East into the mountains, the one from Greenville, one from Spartanburg and one from Salisbury by way of Old Fort, Round Knob and Charlotte.

Since the beginning of my administration there have been twice as many miles of road built, improved roads I mean, in North Carolina as in all the past history of North Carolina; more roads have been built in the State in the past three years than since the time Columbus discovered America; in fact, since the time of Adam. The people are demanding easy and economic means and methods of transportation, and they can't have them with the old-fashioned roads. In 1913 there were but little more than 5,000 miles of improved roads in North Carolina, while now, in 1915, there are more than 15,000 miles of improved roads in North Carolina. We have built in the State since 1913 about 10,000 miles of improved roads, with



Scene on Asheville-Charlotte Highway

more being rapidly constructed. There are about 50,000 miles of roads of all kinds in North Carolina; 15,000 miles of improved roads, leaving 35,000 miles of roads to be improved, and we do most sincerely hope that all of the leading roads in the State may soon be made improved roads that will be a credit to the State and people. The time has come when the horse and the ox will have to get off the highways and give place to some other force more economic in the way of transportation. And

when the people wake up to the importance of better roads we will have them. The time will come when we will have to have good roads whether we want them or not; if not we will be left behind in the march of progress. Good roads mean good farming. A man cannot have a sorry farm with a good road passing by. In dedicating a great public highway like this Hickory Nut Gap road we are dedicating an institution of the same character as the church and the schoolhouse. The men who build roads are serving God too, as is the man who pays the tax to build them, just like the preacher and the school teacher. Good roads mean better corn, better wheat, better churches, better schools, better men, better women. Scrubby men cannot be kept on good highways. They must become better men or get farther back into the hills. I believe that the most favored spot on earth is here in the glorious mountains of North Carolina. It is a land, an inheritance for us, with its marvelous climate, pure water, its brooks and streams and rivers, where we have no flies, or very few of them, because a fly cannot live on these rocks; no malaria, and no diseases except those we can ourselves get rid of. In everything, except climate and rainfall, man can change conditions; everything, except climate, and this wonderful climate we do not want to change, for we cannot make it better. Man can even change the face of the earth, in making things grow where nothing grew before, and even in the matter of rainfall he can make the change, for by irrigation man has changed the desert into a blossoming garden. And there to the convicts, who are coming down to enjoy a day of rest and pleasure with us at the suggestion of Superintendent Mann as we came by, "I have a word of encouragement, for though they have erred, they are yet men, and are doing their duty well."

Following the calling of the meeting together by Columbus Oates, Chairman of the Hickory Nut Gap Highway Committee, the object of the meeting was stated by Dr. Joseph Hyde Pratt, State Geologist, and a member of the State Highway Commission, who spoke in part as follows: "We are here for the purpose of celebrating the construction of the Hickory Nut Gap Highway, the first section of road in the State to be built with State aid. It is a seven mile section of a great highway leading from Asheville to Charlotte. The upkeep and maintenance of this section of highway has been provided for by an act of the legislature, which apportions the expense to the three counties of Buncombe, Henderson, and Rutherford. When the completed road is turned over to the three counties the board of county commissioners of each county will each appoint a commissioner to have charge of the upkeep and maintenance of the road. I speak advisedly when I say we are here to celebrate the construction of the road. It is practically completed. In from thirty to forty days it will be finished. It was thought best, however, to celebrate the construction of the road at the present time rather than to wait until about the first of the year. I wish to impress upon the county officials of the three counties, the importance of maintaining the highway in good condition. Its maintenance is just as important as its construction. The importance of this seven and one half miles of highway can hardly be over-estimated. It will do more for the building up of the tourist traffic in Western North Carolina than any other roads in this section of the State. It will benefit the people as far east as Charlotte and Raleigh. In view of the great cost of constructing it over the mountain, it was impossible for it to have been constructed without State aid. On account of the number of counties and sections of the State benefited by its construction, it is altogether proper that State convicts have been used in building the highway.

Representative Gallatin Roberts and R. R. Williams, speaking for Asheville and Buncombe County, both made short addresses. Representative Roberts paid a tribute to the enthusiasm which the members of the board of county commissioners in Buncombe County are displaying in the matter of building good roads, and declared that the approach to the Hickory Nut Gap road from Buncombe County to the top of the mountain and to the Henderson County line is a marvel in more ways than one. The speaker stated that he wished every taxpayer in the county could see the beauty of this road which winds up a steep mountain with a grade of less than five per cent. Speaking as a representative of the citizens of Buncombe County, Representative Roberts said that he could guarantee that his home county would do its part in maintaining the Gap road. He declared that while chief credit for the building of the Gap road belonged to our good roads governor, Locke Craig, he wished especially to call attention to the ardent support of the highway by Representative Harry Nettles and Guy Roberts of Madison County.

Mr. Williams spoke in part as follows: "The completion of the highway marks an epoch in the building of good roads in North Carolina. The State as a State has taken up the work of aiding in the construction of highways. The bill passed by the legislature of 1913, making possible the building of the highway with State convicts was prepared by Sol. Gallert, of Rutherford County, who brought it to me for introduction. Dr. M. H. Fletcher, who worked unceasingly to make up the funds necessary for the buying of dynamite, and tools for the building of the road, deserves the highest commendation for his labors, as the legislature provided only the convict labor, thus leaving the raising of the other necessary funds to private effort. This road is but a beginning of highway construction in Western North Carolina.

Speaking on the subject of "Building the Highway," Dr. M. H. Fletcher pointed out that although the State had at great expense furnished the convicts for the actual labor of building the road for the buying of supplies it had been necessary to raise $5,000 by local subscription. Of this amount Dr. Fletcher stated the Coxe Estate in Ashville had subscribed $1,000; the town of Edneyville, $1,500 in bond issue voted, while the balance of money collected for this purpose, $5,761.60 spent for dynamite, tools, and supplies, had been secured by collections from citizens mostly in Asheville.

J. S. Mann, superintendent of the State prison at Raliegh, said: "Upon this occasion of the celebration of the practical completion of the highway, I don't believe any man can properly appreciate the value of this road. It has already compelled the building of several connecting links. It is of great advantage to the people of the mountainous sections of the State. It gives them three markets for their products, and through these local markets, they can reach any market in the country with their products. In addition it is a standing invitation to tourists to visit this beautiful country.

Others who spoke were H. B. Varner of Lexington, N. C., Sol Gallert of Rutherfordton, Dr. George T. Winston of Asheville, and Mayor Brooks of Hendersonville.

County commissioners, with other county officials, attended the celebration in a body.

Following the speaking, the hundreds attending the celebration were entertained at a picnic lunch served by the residents of the Hickory Nut Gap highway. Probably one hundred automobiles were used by the various delegations and guests attending the meeting, many of whom made the return trip to Asheville over the new highway by way of Bat Cave, Hendersonville, and Biltmore.

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## New Jersey

### Work which passed through the Department of Public Roads during the last fiscal year

RIVER ROAD, Sections 1 and 2, Mercer County.

These sections are a part of the proposed Delaware River Drive, which it is intended to improve from the city of Trenton northward to the New York State line, thus opening to the inhabitants of the State capital and others one of the most beautiful scenic roads in the State of New Jersey.

*Section* 1, two miles in length, is to be constructed with Portland cement concrete, 18 feet wide and 6 inches thick. Contract was let to the Utility Construction Company, of New Brunswick, New Jersey, for $38,289.25, with five (5) years' maintenance.

*Section* 2, 2.877 miles in length, is to be constructed with part waterbound macadam and part Telford foundation, 6 inches of the former and 8 inches of the latter, with a 2-inch bituminous concrete top. Contract was let to the Newton Paving Company, Trenton, N. J., for $73,244.74, with five (5) years' maintenance.

VINCENTOWN-BUDDTOWN ROAD, VINCENTOWN-EAYRESTOWN ROAD, Burlington County.

These two roads form an east and west line through a very rich farming district and furnish an outlet for the farmers and

truck raisers in this region to the improved roads leading to the Camden and Philadelphia markets.

*Vincentown-Buddtown Road,* 2.515 miles in length, is to be constructed of waterbound macadam, 9 feet wide and 3 inches thick. Contract let to Manwaring & Cummins of Philadelphia, Pa., for $5,710.40.

*Vincentown-Eayrestown Road,* 2.015 miles in length, is to be constructed same as above road and let to the same contractors for $4,578.85.

NEWTON-SPARTA ROAD, Sussex County.

This road extends easterly from Newton, the county seat of Sussex, to Sparta, thence through to Ogdensburg, and furnishes a smooth and convenient outlet for a large portion of the population of the eastern part of this county to the county seat. It will also, in time, form a connection with the inlet to the county by means of the Paterson and Hamburg Turnpike, bringing one of the most beautiful scenic regions of the State within a convenient automobiling distance of New York and Newark.

*Newton-Sparta Road,* 4.966 miles in length, is to be constructed of waterbound macadam, 16 feet wide and 7 inches deep. Contract let to Richards & Gaston, Somerville, N. J., for $57,162.60.

HEIGHTSTOWN-PRINCETON JUNCTION ROAD, Mercer County.

This road forms a through inlet and outlet to Princeton from Heightstown, Freehold, and the Atlantic shore, reducing the present distance between Princeton and the seashore roads by about four miles. It also opens up a very fine farming section.

*Heightstown-Princeton Junction Road,* 4.887 miles in length, is to be constructed of waterbound macadam, 16 feet wide and 6 to 9 inches deep. Contract let to Manwaring & Cummins, Philadelphia, Pa., for $52,573.95.

BAYHEAD-POINT PLEASANT ROAD, Ocean County.

This road is an extension of the improved roads and streets of Point Pleasant with the improved streets of Bayhead, and forms a connecting link which renders these improvements doubly valuable to both communities.

*Bayhead-Point Pleasant Road,* 0.565 miles in length, is to be constructed of gravel, 24 feet wide and 8 inches thick on the center line and 4 inches at the shoulders. Contract let to Richard Hafeman, Freehold, N. J., for $3,359.50.

BARNEGAT-BUDDTOWN ROAD, Ocean County.

The Barnegat-Buddtown Road forms the first section of a proposed new through line from Barnegat, westward toward Mount Holly and Camden, and when completed will form the most direct line from Barnegat Bay to Camden and Philadelphia.

*Barnegat-Buddtown Road,* 6.098 miles in length, is to be constructed of gravel, 24 feet wide and 8 inches deep on center line and 4 inches at shoulders. Contract let to L. W. Holman, Whitesville, N. J., for $22,668.84.

BUTTZVILLE-DANVILLE ROAD, change of line and grade, Warren County.

This small section eliminates a very dangerous curve near a schoolhouse and might well be termed a "Safety First" road, for the reason that it will divert the direct traffic from Paterson and eastern New Jersey to the Delaware Water Gap away from the schoolhouse and grounds which, under the old road, was located at a very sharp turn. The present line is almost a direct course past the school and will enable the traveling public to avoid collision with any of the school children who may, unfortunately, be playing in the street.

*Buttzville-Danville Road,* 0.360 miles, is to be constructed of waterbound macadam, 16 feet wide and 6 inches deep. Contract let to Smith Brothers Company of Hackettstown, N. J., for $7,916.70.

GRENLOCH ROAD, Camden County.

This road marks the completion of the Camden and Blackwoodtown Turnpike from the city of Camden to the Gloucester County line. This will, in connection with the Grenloch-Cross Keys Road, complete this through line to Williamstown in Gloucester County, and will eventually form a part of the through line to Mays Landing and thence to Cape May.

*Grenloch Road,* 1.47 miles in length, is to be constructed of waterbound macadam with bituminous concrete surface, 16 feet wide and 8 inches deep. Specifications have been approved.

* * *

## "Too Many Highway Meetings"

"Why should there be two separate national organizations of highway engineers, each holding an annual convention to which all highway engineers the country over are invited and to which all manufacturers of highway supplies and machinery are urged to bring exhibits? The question has been asked with increasing emphasis by highway engineers all over the country, who would like to attend one convention a year at which the leading men of the industry were assembled, but who cannot and will not afford the time and expense necessary to attend two. This question has been asked with even greater emphasis by the firms dealing in highway supplies and machinery, many of whom have declared that they will no longer undergo the heavy expense of making exhibits at the conventions of two rival associations covering the same field. Practically the same group of men visits the two conventions, and thus expense is doubled and the attendance duplicated.

"At the time the American Road Builders' Association was organized, a number of prominent engineers gave it their active support in the belief that the older organization, the American Highway Association, was giving too much prominence to the political end of the good-roads movement and was in danger of becoming an organization whose chief aim would be to secure Federal appropriations for road construction.

"That danger, if it existed, long since passed away. Each of these societies has come to be primarily an organization of engineers and others actively engaged in road construction. These are the men who constitute the strength of each organization, and it is the papers and discussions from these men that give standing to the meetings of each society. Papers read before one society deal with the same subjects as those read before the other, and often are written by the same authors. The exhibits of road machinery and supplies, which form one of the most important features of the annual convention, are practically identical at each meeting.

"Why, then, should the highway engineers and the highway industry continue to support two rival associations, covering practically the same field? Why should there not be one strong association, with such standing that its work would have the same authority as that of the American Society for Testing Materials or the Automobile Engineers' Society?

"These are the questions which confront the officers of the two societies, and it remains to be seen how they will solve the problem. What seemed to some like an initial step toward co-operation was taken last fall when two organizations agreed to hold an 'International Highway Congress' at Oakland, California, in September, under the joint authority of the two. It has developed, however, that the co-operation in the Oakland meeting was not meant to establish a precedent for future meetings. Further, the Oakland meeting was so nearly a failure that it gave little encouragement that joint conduct of meetings, with the two associations continuing their independent existence, was a good solution of the problem.

"Another attempt of this sort, however, is now being made. The Board of Directors of the American Road Builders' Association, at a special meeting on December 16th., decided to hold a convention in Pittsburgh, beginning February 28th., and held out a small olive branch to the rival association, inviting it to hold its convention at the same time and place, the program of the two conventions to be arranged by a joint committee of the two associations. At the same time, the directors declared that the consolidation of the two associations is 'inexpedient' at the present time, and that the holding of a joint convention is impracticable. What response the American Highway Association will make to this invitation remains to be seen, but it appears extremely doubtful whether it will consent to have the time and place of its annual convention fixed by the rival association.

"One hears no very urgent demand for the holding of a national meeting of highway engineers of all classes at the date proposed. The highway engineers of New England have just attended, in very considerable numbers, an "International Road Congress" at Worcester, which was engineered by the Wor-

cester Chamber of Commerce. In Chicago, on February 16 to 18, there is to be held a second national conference on concrete road construction, a meeting which, while devoted to one specific class of road work, promises to attract a large attendance and to perform a very useful work.

"The situation is one which admits of no half-way measures. There is need of a strong, influential, national engineering organization devoted to highway construction and maintenance. Such an organization can be made powerful and prosperous, and room can be found in it for men who are interested in all the different aspects of highway construction. It need not be an organization merely of engineers. But there is not room for two rival organizations in this field. Those who are appealed to for financial and technical support are ready to proclaim "A plague on both your houses." It is time that personal differences and preferences were put to one side; and while these past differences are doubtless to permit either association to commit hara-kiri for the benefit of the other, it ought to be possible to organize a new association on proper lines with independent officers in no way tied up to the rivalries of the past, and have the two old associations bequeath to it all their possessions and wind up their existence. Any measure less radical seems little likely to succeed."

The foregoing is an editorial in the December thirtieth issue of Engineering News, well known as the leading engineering publication and authority for civil engineers. That publication is to be most heartily commended for the forceful stand which it has now openly taken, and readers of Better Roads and Streets will appreciate the fact that such a strong power comes out and openly takes the same stand that this publication has advocated and even demanded for at least two years. Better Roads and Streets inaugurated the move for one and only one big national road convention per year, and has been incessantly after this end ever since. The policy is, and will continue to be to recognize and support either one national convention and its allied exhibit of road materials and equipment, or to recognize and support NO national, or so-called national meetings. In this stand, we are supported by more than a score of the very largest manufacturers of road machinery and road materials, every one of whom has pledged to exhibit at one real national meeting or at no national meeting.

This does not mean that we are opposed to and will not support and report some of the sectional meetings, and the meetings of the various organizations, such as the annual road meetings of certain sectional road organizations, the meetings of the American Society of Civil Engineers, of the American Society for Testing Materials, of the American Society of Municipal Improvements, of the American Society for the Advancement of Science, which always has an important series of sessions on road materials and construction, and of the meetings of the associations representing the Portland cement, crushed stone, paving brick, granite block, wood block and the asphalt interests. It does mean, however that we will not support the rival national road associations individually, nor give them recognition of any kind. We have on numerous occasions explained this attitude to the leading manufacturers and material concerns in the United States, and these have in every single instance heartily commended us for this stand. Better Roads and Streets has nothing of any kind against either the American Highway Association or the American Road Builders' Association, or against any of the officials of either organization. But it has been and will continue to be positively opposed to the past policy of both of these associations holding annual road congresses. Canada has found that one big road congress annually is profitable and beneficial from every standpoint, and that it has been and is supported and aided by the Dominion, as well as by the Provincial Governments. We will find out just the same thing in this country, and what seems, without question, the most logical and the simplest way of bringing about this condition is the acceptance of the plan proposed by Engineering News in the editorial which we quote in full. If this is done, every possible assistance and full support will be given the new association by Better Roads and Streets. The plan is easily feasible, so why not let us all join hands and purposes and get in line, insisting upon and working for that ONE BIG NATIONAL ROAD CONGRESS ANNUALLY, a congress that will carry with it more weight and be more powerful than all the so-called national congresses which we have been inflicted with during the past five years. If we have one road association of national scope, holding one annual road congress of national importance, such an organization will without the slightest doubt become just as powerful in road matters as the American Society for Testing Materials or the American Society of Municipal Improvements have become in their special lines of endeavor. This can never be accomplished, however, as long as there are two rival organizations working along the same lines in the same field.

* * *

## A Study of the Sands

### By A. D. Williams, Chief Engineer of West Virginia

IN the construction of permanent roads, the engineer is confronted with the problem of materials and the value of a highway engineer's service is in a degree dependent upon his knowledge of materials and ability to select the proper ones for each individual road. To be able to get the best results from any material, the engineer must have made a study of its actions under varied conditions so as to determine its merit and worth in each case.

In modern road construction, the sands are in constant demand. If it is not for the surface of the road, it is wanted in the construction of bridges, culverts, and drains. It would be hard to point to a mile of permanent road that was constructed without the use of sand in some manner; therefore the need of a knowledge of this material.

In early life, the speaker passed many hours tossing tiny handfuls of sand at a smaller sister or brother and in seeing how much water could be put into a vessel filled with sand and then wondering where the water went. Later years have revealed partial answers to some of those mysterious questions but a careful study of the question has shown that there is much yet to learn before the very common old sand pile is thoroughly understood and utilized to its real value. The failure of concrete structures and of concrete road is in many instances due to the engineer not knowing the value of the sand used in the work. There should be more stress laid on the sand in many cases than on the cement that enters the work. The only way to know a sand is to test it with care. Some of this can be done in the field, but before any sand is used in work of any importance it should undergo a careful laboratory study.

A test of twenty-eight different sands with the same cement showed varied tensile strengths at twenty-eight days ranging from 193 to 531 pounds. The strength of mortar is dependent upon its density, compactness, and adherence of particles, which is in turn dependent upon the structure of each part and the condition of the surface.

Many things enter into the sand problem that have a bearing upon its values; any one of which, when overlooked, may be of sufficient effect to impair or destroy the value of the sand. A thin film of clay over the grain will act as an insulation and in some instances when placed under the microscope the grain can be seen nested in this jacket loose and free from the mass it is supposed to be associated with. In this case the grain is probably not serving the structure more than a tenth of its theoretical capacity. This condition can often be remedied by washing, but in some cases this is not true. In one instance under the speaker's observation during the past season, a sand was discovered to be of greater value unwashed than when washed. This was due to the uniform size of the grain and the material which went out in the washing being a finely broken sand which possessed strength and helped to make a denser mass while under the microscope it was shown that the larger grains were not coated by a sedimentary deposit. It is possible to add some clays to a mixture without very great injury, but it is risky and not to be recommended.

It is not possible to judge a sand by merely looking at it with the eye or by handling it. The speaker has been with engineers that have condemned sands that when tested produced superior mortar to a sand procured from a distance and at a greater cost; therefore, he would recommend a scientific study of the sands of each locality so as to get the maximum efficiency at a minimum cost in construction and maintenance of concrete structures and roads.

# Better Roads and Streets

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Subscription Agents Wanted Everywhere. Good Commissions


Everywhere roadways which have not been drained have the appearance of canals.

* * *

Final arrangements will be made by the city authorities of Creston, Iowa, on February 7, for the construction of 100,000 yards of street paving and 75,000 feet of curbing.

* * *

We usually wait until March for the bottom to go out, but it went out last week, and in almost every case where there was no bottom at all and no drainage where ditches ought to be.

* * *

BETTER ROADS AND STREETS, DAYTON, OHIO, that's where to send copy and cuts for advertisements, that's it, that's all, and that's the way to address it.

* * *

When a polished promoter or salesman visits you in the interest of some material or machinery which is not advertised in these columns, just ask him why his firm does not advertise in "Better Roads and Streets."

* * *

The restoration of the half-mill levy for roads in Ohio is demanded by everybody. The State levy was not abolished, simply reduced from five-tenths to three-tenths, and three-tenths raises about a million less money than five-tenths.

* * *

All copy and cuts for advertisements in this publication should be mailed direct to Better Roads and Streets. Dayton, Ohio—just *"Better Roads and Streets,"* Dayton, Ohio, and that will insure immediate attention and prompt service.

* * *

Ditchin', ditchin', ditchin'.
It 's needed.
It 's important.
It 's necessary.
Everybody ought to be at it.

* * *

We have no personal complaint to offer against manufacturers who do not advertise in this publication, but we do recommend to all of our readers that they read the advertisements contained in Better Roads and Streets, and then get in touch with our advertisers before purchasing machinery or materials.

* * *

If you don't toot your own horn, nobody else will toot it for you; therefore we're tootin', and want you to call the attention of your friends to the fact that you receive more information from reading "Better Roads and Streets" than you do from several other publications all combined, that the subscription price is but one dollar per year, and urge upon your friends the importance of subscribing.

* * *

Wonder if the present administration is thinking anything about that plank in the Baltimore platform which said something about roads? War or no war, reduced revenues or not, if Congress does not do something to carry out the road plank in the Baltimore platform somebody is going to be disappointed when the votes are counted this fall.

* * *

January has been some month, the thermometer eight degrees below one day, sixty-five above the next day, pouring down rain for two days, mud up to—we do not dare mention where in print, everybody floundering around in it, only a few miles of roads improved here and there, and everybody cussing conditions, war going on in Europe, and hell to pay everywhere.

* * *

Rural mail carriers are having a difficult time to go "through" their routes. I didn't say "over," for they couldn't keep on top. This is another reason why the Federal Government should build a system of National Highways. Better to do something of this kind than to throw away the horse and wagon, double the mileage of every route, and compel the mail boys to buy automobiles to travel in. Just watch them when the bottom goes out again.

* * *

Retail merchants in cities and small towns, and especially the latter, who have been kicking because farmers did not come to town to trade or pay their bills, should go out and examine the roads leading into town, for during January the roads were impassable, and it was impossible for farmers to either get to town or to deliver farm products to the market place; and when farmers cannot deliver their products they do not have money to pay their bills.

* * *

A short course in Highway Engineering will be held at the University of Michigan, February 21-25, 1916, under the direction of the College of Engineering and in co-operation with the Michigan State Highway Department.

Not only engineers, but all road officials and prominent citizens in the State of Michigan should attend that course and there get information relative to not only the proper construction of roads and streets, but as to the proper application of road and street materials.

* * *

The Third Road Institute of North Carolina will be held at the University of North Carolina, Chapel Hill, N. C., under the auspices of the State University, the State Highway Commission, and the North Carolina Geological and Economic Survey, February 7-12, 1916, inclusive. The two previous institutes have proved of great value to the engineers and superintendents attending them and it is the purpose of the director to make this one of even more practical value.

A subject which will be given especial emphasis this year is that of road maintenance.

* * *

## Surface Oiling of Earth Roads

The State Highway Department of Illinois has recently published an illustrated pamphlet entitled, "Surface Oiling of Earth Roads," prepared by B. H. Piefmeier, maintenance engineer. It covers this comparatively new form of earth road maintenance in a very thorough manner and is a particularly valuable addition to road engineering literature because of the scarcity of other authoritative data on the subject.

There has been quite a demand for earth road oiling in Illinois, and others of the Central States, during the past year, and it is the purpose of this pamphlet to disseminate information regarding the best method of treating various types of soils ranging from heavy black loam to light sand.

* * *

The Dunn Wire-Cut Lug Brick Company, of Conneaut, O., has had two prominent additions to its family of licensees, the Burton-Townsend Company, of Zanesville, O., with two plants and a present daily capacity of 160,000 pavers, and the Trimble Paving Brick Company, of Dayton, O., with one plant at

Trimble, O., and another at Gloucester, O. These two companies are among the largest and most prosperous in Ohio.

In addition, the Deckman-Duty Brick Company of Cleveland, O., another Dunn Licensee, has consolidated with the Wooster Shale Brick Company, of Wooster, O., under the name of the Medal Paving Brick Company. This adds one more plant to the three which the Deckman-Duty company owned—one at Cleveland, O., one at Carrollton, O., one at Malvern, O.

These accessions give the Dunn company 30 licensees, operating 49 plants.

* * *

The annual meeting of the Inter-State Stone Manufacturers Associations was held at Columbus, Ohio, January 19, 1916, and closed with an annual dinner attended by the largest number of members ever seen at an annual convention of that association. At the afternoon and night sessions, addresses were delivered by Governor Frank B. Willis; State Highway Commissioner Clinton Cowen; S. M. Williams, the Good Roads booster of the Garford Motor Truck Company; Ex-Congressman Ralph D. Cole; H. M. Sharp, chief engineer State Highway Department; A. H. Hinkle, deputy, Bureau of Maintenance and Repair, State Highway Department; J. R. Chamberlin, deputy, Bureau of Bridges, State Highway Department; and Engineer Arch W. Smith, of the State Highway Department.

At the annual election of officers, S. P. Selby, of Toledo, was chosen to succeed himself as president, and Jesse Taylor, of Jamestown, for another term as secretary. Allen Patterson, of Lima, was made first vice president; J. B. Klunk, of Toledo, second vice president; and L. H. Hawblitz, of Toledo, treasurer. Trustees of the association are: A. A. Hall, of Piqua; G. A. France, of Toledo; C. L. Reinheimer, of New Paris; W. H. Hoagland, of Columbus; J. A. Moore, of Bellevue; E. T. Paul, of Lewisburg; J. F. Pogue, of Findlay; J. F. Mollen, of Maple Grove; and the officers of the association.

* * *

It now looks like the future will be hard sledding for the "Convention Promoters."

The Cement Show, at Chicago, a well-organized exhibition by the manufacturers of cement.

That 's proper.

To promote the use of cement, material, and machinery used in the application of cement.

This will be followed immediately by the annual convention of the National Paving Brick Manufacturers at Cleveland.

That 's proper.

For it will be the annual meeting of all individuals, firms, and corporations interested in the promotion of the use of paving brick, appliances, materials, and machinery used in connection with that industry.

Immediately following this, some convention promoters are going to attempt to hold another annual road show.

It is supposed by these road convention promoters that manufacturers have nothing else to do but to go, send their men and exhibits to so-called road conventions, and just after manufacturers of cement, cement machinery, etc., paving brick, brick machinery, etc., are only home from their own annual conventions, that they will pick up "body, bays, and breeches," neglect their business, and go to some so-called road convention just because some convention promoter has called it such.

* * *

The Jaeger Machine Company, of Columbus, Ohio, began the manufacture of a batch mixer about three years ago, during which time they have placed on the market many mixers which were sold within their own State, and the contractors who have purchased and used them are very enthusiastic about their purchase. During their three years as a manufacture of batch mixers, they have learned much and have made quite a few changes, and the contractors who now become purchasers of their mixers will benefit by their experience. The mixer which they will place on the market for 1916 will be increased in size so as to make the capacity of mixing drum up to twelve cubic feet per batch. One new feature of the larger machine will be the point of discharge will be a great deal higher so as to give more fall to the spout.

Although the price is going to be advanced, on account of the fact that the prices in the past have been right and the marked increase in the price of raw materials will make the price advance accordingly, but it will still be built, sold, and known as the lowest paver with all the features and advantages that can be asked for and desired.

The Jaeger Machine Company was awarded a gold medal for their concrete mixer exhibited at the Panama-Pacific International Exposition recently held at San Francisco, California. Not only was the company awarded a medal, but Mr. Jaeger was awarded a silver medal on account of the artistic design of the machine and the way it was carried out. They are just in receipt of their gold medal ribbons, which are on display in their office in Columbus, Ohio.

The Jaeger Machine Company will have their mixer on exhibit at the Gold Medal Winner Association Exposition at New York City, N. Y., on February 12-22, 1916, and at Chicago, Illinois, on March 1-12, 1916.

* * *

It will be profitable for everybody to read with us from "Roads and Railroads," by W. M. Gillespie, LL.D., C. E., published in 1853. Although conditions during the past two weeks have positively demonstrated the necessity of drainage, many of our present-day engineers are overlooking the fact that drainage is not only necessary in connection with new construction, but that millions of dollars worth of roads are going to destruction for want of drainage.

Under "Ditches," Gillespie said, "The drainage of a road by suitable ditches is one of the most important elements in its condition."

"All attempts at improvements are useless till the water is thoroughly got rid of."

"A bad road may often be transformed into a good one by merely forming beside it deep ditches, sufficiently inclined to carry off immediately all the water which falls upon it."

"Even if the water does not stand on the surface so as to form mud, if it filtrates from the higher land beside it, and from springs under it, and is not well drained off, it will weaken the sub-stratum of the road so as to render it incapable of bearing heavy loads, and will be absorbed into the upper stratum by capillary attractions."

"In wet soils the ditches should be so wide and deep that the earth taken from them may be sufficient to raise the bed of the road between them three feet higher than the natural surface."

"There should be a ditch on each side of the road on level ground or in cuttings, and on the upper side of the road where it is on a hillside."

Under the title, "What Roads Ought to Be As to Their Cost," Gillespie said: "Minimum of expenses is, of course, highly desirable; but the road which is truly cheapest is not the one which has cost the least money, but the one which makes most profitable returns in proportion to the amount which has been expended upon it."

Under the title, "Improvement of the Surface," Gillespie said: "A very good substitute for the scraper in leveling the surface of a road, and filling up the ruts, consists of a stick of timber, shod with iron, and attached to its tongue or neap obliquely, so that it is drawn over the road 'quartering,' and throws all obstructions to one side. The stick may be six feet long, a foot wide, and six inches thick, and have secured to its front side a bar of iron descending half an inch below the wood." Since we read this from Gillespie we inquire of the many claimed-to-be "split log drag" inventors if some of them did not take the idea from Gillespie.

Under the title, "Rolling," Gillespie said, "Every part of the road should be passed over by the roller from forty to one hundred times."

Under the title, "Keeping Up the Road," he said: "Keeping up the road requires the daily attention of a permanent corps

of laborers. Supposing the road to be already in good condition; that is, in proper shape, and free from holes, ruts, mud, and dust; to keep it so requires two fundamental operations, one the continual removal of the daily wear of materials, whether in the shape of mud or dust; two, the employment of materials to replace those removed. The number of men required by this system of constant watchfulness may at first seem an objection to it, but the expense will be amply repaid by the advantages obtained. Each laborer should have a certain length of road assigned to his especial care, and the most intelligent and trustworthy among them should be made inspectors over the others for a certain distance."

Under the title, "Repairing a Road," Gillespie said: "A road properly kept up by daily attention needs no repairs; but if it be put in order only at intervals, the injuries to it, which have been increasing in geometrical progression, will render very serious repairs necessary."

We are indebted to T. C. Powell, of the Queen and Crescent Railroad Company, Cincinnati, Ohio, for a copy of this most valuable old book, and we recommend to all young engineers that they buy, beg, borrow, or steal a copy of it and study it from cover to cover before spending another dollar of the people's money, or making any more specifications, for the construction of public roads. Too many of the simple things are neglected in present-day road construction, and too little attention is being paid, in fact in most localities none whatever, to the repair and maintenance of public roads and streets.

From the introduction in this splendid old book we quote as follows: "The roads of a country are accurate and certain tests of the degree of its civilization. Their construction is one of the first indications of the emergence of a people from the savage state; and their improvement keeps pace with the advances of the nation in numbers, wealth, industry, and science—of all which it is at once an element and an evidence."

"Roads are the veins and arteries of the body politic, for through them flow the agricultural productions and the commercial supplies which are the life-blood of the State Upon the sufficiency of their number, the propriety of their directions, and the unobstructedness of their courses, depend the ease and the rapidity with which the more distant portions of the system receive the nutriment which is essential to their life, health, and vigor, and without a copious supply of which the extremities must languish and die."

"But roads belong to that unappreciated class of blessings, of which the value and importance are not fully felt because of the very greatness of their advantages, which are so manifold and indispensable, as to have rendered their extent almost universal and their origin forgotten. Perhaps we will better appreciate them, if we endeavor to imagine what would be our condition if none had ever been constructed."

* * *

The Egyptian Trail, from Chicago to Cairo, Illinois, is to be marked this spring.

* * *

At a meeting of the State Highway Commission of Tennessee, held Monday, January 10, A. M. Nelson was appointed State Highway Engineer of Tennessee.

* * *

Street names will be stamped into the cement curbs in all new street work according to City Engineer Heartwell, of Hastings, Nebraska. A die with movable letters will be used.

* * *

Another meridian road is being promoted in Illinois, following the third principal meridian from Beloit, Wisconsin, to Cairo, Illinois, and passing through Rockford, LaSalle, Bloomington, Decatur, Vandalia, and Centralia. Malcolm MacKinnon, of Rockford, is president.

* * *

Hard roads have received a big boost in Cerro Gordo County, Iowa, following the recent report of County Engineer, R. E. Robertson, Mason City, which shows an expenditure of $2,827 for dragging unimproved roads. The county's road system comprises 149 miles of which only two miles are provided with a hard surface. Each mile of unimproved road was dragged an average of 25.3 times during the year 1915 at a cost of $19.22 per mile per year.

* * *

W. E. Weller has been appointed city engineer of Binghamton, N. Y., and has resigned as acting city engineer of Schenectady, N. Y., which position he had been filling for some time past.

* * *

The Deckman-Duty Brick Company and the Wooster Shale Brick Company have merged their plants and the properties under the name of The Medal Paving Brick Company. The general offices of the company will remain at 1305-08 Swetland Building, Cleveland, Ohio, and the officers of the association are: Spencer M. Duty, president; Chas. J. Deckman, vice president; Herbert C. Moatz, treasurer, and W. R. Barnhart, Jr., secretary. The plants of the new company are located at Cleveland, Carrollton, Malvern, and Wooster, Ohio.

* * *

Eight roads, each eight miles in length, will be built in eight directions out from Sulphur Springs, Texas, with the proceeds of a $400,000 bond issue voted at a special election held December 18, 1915. Sidney Suggs, of Ardmore, Oklahoma, former State Highway Commissioner of Oklahoma, was one of the principal speakers at meetings held prior to the election.

* * *

## Property Owners Will Plant Trees

If the plans of the property owners along the ten-mile road between Mason City and Clear Lake, Iowa, are carried through, this will be one of the most beautiful drives in the State. A meeting was recently held at which it was decided to have trees planted along the road for the entire distance. Six miles of the road are improved and the remaining four miles will be paved during 1916.

* * *

Over thirty-nine miles of road were improved in Rock County, Wisconsin, with State aid during 1915 according to the recent report of County Highway Commissioner, C. E. Moore of Janesville.

| Type | Feet | Miles |
|---|---|---|
| Concrete | 7,150 | 1 1/3 |
| Stone macadam | 23,450 | 4 1/2 |
| Gravel macadam | 176,088 | 33 1/2 |
| Total | 206,688 | 39 1/3 |

Twenty miles of road received surface treatments of oil at a total cost of $4,505.45.

* * *

## Patrol System in Buchanan County, Missouri

The patrol system of maintenance has been inaugurated in Buchanan County, Missouri, by county highway engineer, Ray Cargill, St. Joseph. It is to be tried out first on the DeKalb road, a fourteen mile macadam road southwest from St. Joseph, paralleling the Missouri River to the town of DeKalb. The road will be divided into two sections of seven miles each and each patrolman will have a horse and light wagon for the necessary road implements and supplies.

On this first experiment the expense is to be shared by the county and abutting property owners. If successful, it will be applied to other important roads in the county.

* * *

## Marsh-Capron Gets the Prize

Since the publication of the article "First Paving Mixer to Work in Chicago's Congested Loop District" in the January issue, it has been brought to our attention that a Marsh-Capron was used to put in the concrete base on West Monroe Street in the early fall of 1914—nearly a year before the Washington and Van Buren Street jobs. A. N. Todd, of Oak Park, Illinois, was the contractor.

So we will have to award the honor to Marsh-Capron, unless some one else can "come across" with further information.

* * *

"The Asphalt Primer and Colloidal Catechism" issued by The Barber Asphalt Paving Company, Philadelphia, contains

in question-and-answer form an easily understood explanation of the principles of colloidal chemistry as applied to the paving industry. An asphalt mixture, it is explained, must be regulated on the basis of the relation of surface and films. The presence of colloidal matter such as has been discovered in Trinidad asphalt enormously increases the surface area of the aggregate and results in a more closely held and thicker film of bitumen about the particles of the aggregate. In this way is explained the "body" of Trinidad asphalt and the toughness and stability of mixtures in which it is the cementing agent. The Primer is a replica of one of Benjamin Franklin's publications and is illustrated with wood-cuts of ancient and modern highway building.

* * *

One of the most interesting stories ever published in this, or any other magazine, was the one, "Why the Boys and Girls Leave the Farm," by Grace Boteler Sanders, in our March issue, 1915. Our next issue, March, 1916, will contain a well-written story by the same author, "Another Reason Why the Boys and Girls Leave the Farm."

* * *

Co-operation in all things is necessary, and the most valuable co-operation a subscriber can give us will be, just as soon as he has completed reading his copy of BETTER ROADS AND STREETS, to hand it to some road or street enthusiast, request him to read it and then mail a dollar to us for a subscription. By that way the present subscriber can assist us to double our subscription list in a very short time.

* * *

To have but one national road congress will be to materially reduce the annual expenses of all manufacturers of road and street machinery and materials so that they can have some money left with which to keep efficient salesmen in the field to get in touch with the real purchasers of machinery and materials, for the record is that but very few of those who chase after the many so-called national road shows have power to purchase anything. The real man who has power to purchase is busy at home, and the first competent salesman who reaches him is the fellow who sells him.

If you desire that something be called to the *attention of the editor*, then send it to *Jamestown, Ohio*, for that's where he lives, a little town, a village, just thirty miles out of Dayton, but if you have *copy and cuts for advertisements* then *send* them to *BETTER ROADS AND STREETS, DAYTON, OHIO,* and the postmaster at Dayton will deliver them to the U. B. Publishing House, one of the largest printing establishments in the whole country, that's where *Better Roads and Streets* is printed and mailed, and copy and cuts for advertisements correctly addressed will have immediate and proper attention.

Mr. Walter H. Kestin has been appointed sales manager for the concrete machinery department of the Northwestern Steel & Iron Works, Eau Claire, Wisconsin.

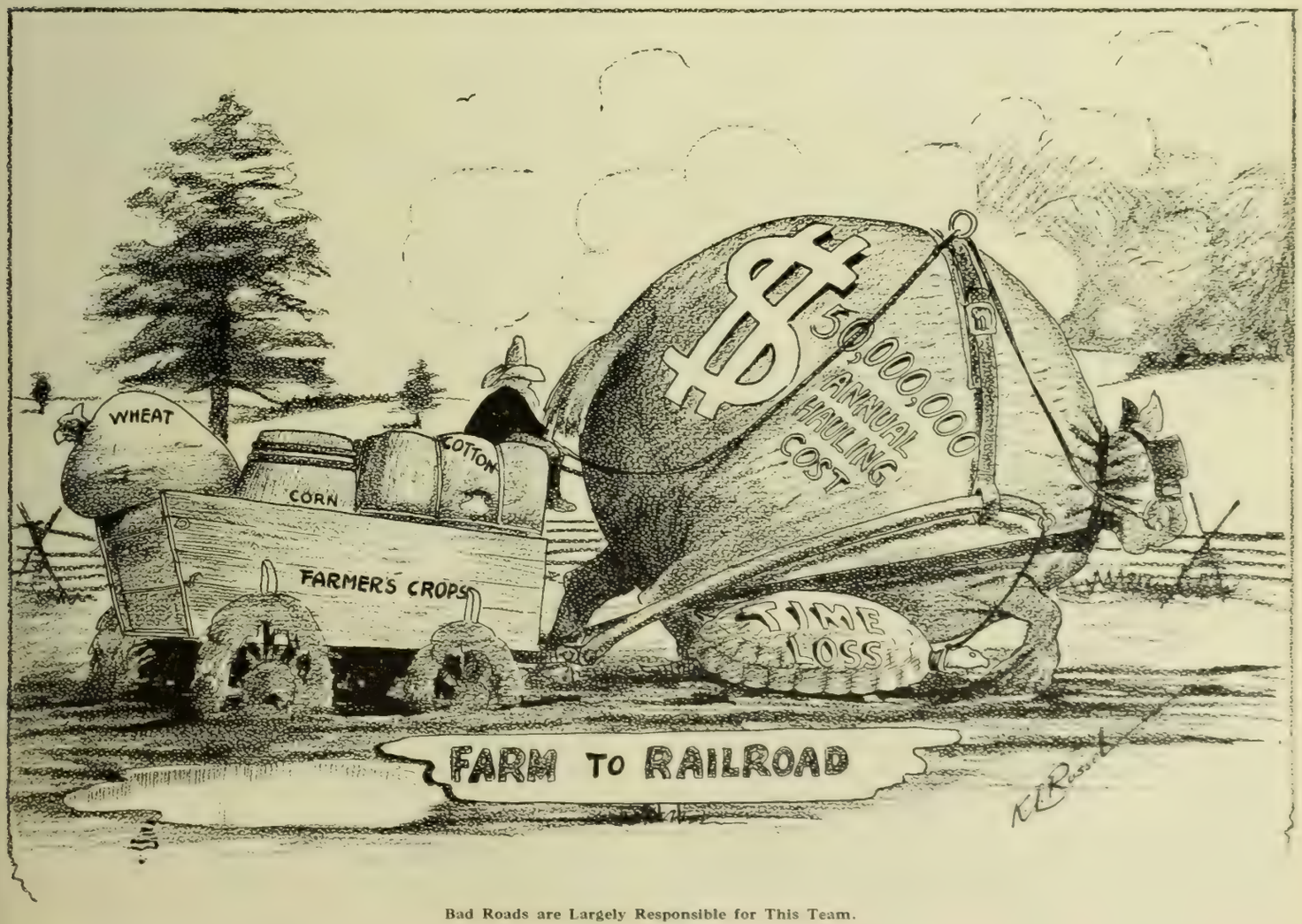
This addition has been made necessary by the marked increase in the demand for Northwestern mixers and the return of activity in the building lines.

Mr. Thorman W. Rosholt, vice president of the company who has heretofore devoted a portion of his time to this work, will, in the future, devote more of his time to work among the trade.

Mr. E. R. Hamilton, secretary and general manager, states that they have had a substantial increase in the business during the past twelve months and that present indications seem to insure still greater gains for the coming year.

* * *

The annual Good Roads Week, at Cornell University, which was inaugurated last year, and which was scheduled for the week of February 14, this year, has been postponed until the following week. An elaborate program is being prepared which will include lectures, papers, and discussions on practically every form and type of road construction, maintenance, and repair, and in addition to this technical program there will be a large number of tests and demonstrations of road machinery,




Bad Roads are Largely Responsible for This Team.

and laboratory tests of materials. The attendance at this meeting was large last year, but it is expected that it will be much larger this year, as practically all of the road engineers and road contractors of New York State and the New England States expect to attend during one or more days.

* * *

At a meeting held at the Hotel Pfister, on January 14, 1916, the organization of the Wisconsin Crushed Stone Association was completed and the following officers elected:

President, A. J. Blair, Milwaukee.
Vice President, John J. Sloan, Chicago.
Sec'y-Treas., L. D. Smith, Sturgeon Bay, Wis.
Directors:
A. L. Story, Milwaukee.
John D. Ohrt, Lannon, Wis.
John J. Sloan, Chicago.
Herman A. Martens, Mayville, Wis.
Leathem D. Smith, Sturgeon Bay, Wis.

A permanent secretary will be selected within a short time.

* * *

## Stone Producers of Wisconsin Organize

Attended by representatives of two-thirds of the stone producers of Wisconsin, representing more than seventy-five per cent. of Wisconsin's large output of limestone, sandstone, trap, and granite used in road and street work. A meeting was held at the Hotel Pfister, Milwaukee, on January 7, 1916, at which time the Wisconsin Crushed Stone Association was formed.

The temporary officers selected were A. S. Blair, president, L. D. Smith, secretary, and an executive committee consisting of five were appointed to draft constitution and by-laws and complete the organization. This committee consists of A. S. Blair, of the Lake Shore Stone Company, Milwaukee; John S. Sloane, of Wisconsin Granite Company, Chicago; John D. Ohrt, of Davis Brothers Stone Company, Lannon, Wisconsin, and G. D. Francey, of Francey, Stolle, Stone & Supply Company, Milwaukee, and L. D. Smith, of the Leatherman & Smith Towing & Wrecking Company, Sturgeon Bay, Wisconsin.

* * *

## One National Road Congress

No matter how many road conventions, road congresses, or road exhibits may be called by convention promoters, we are still for *one* national road congress, and intend to continue to advocate one, and only one national road congress until manufacturers realize that one is enough and firmly declare that they will not buy space or send exhibits to but one national road congress. Just as soon as manufacturers do this we will have only one, for promoters of conventions can't run road shows unless manufacturers will buy exhibit space, send exhibits, and help the promoter make up his crowd by sending their salesmen with the exhibits. Of course the multiplicity of road congresses furnishes places for salesmen and representatives of manufacturers to hold reunions, but car fare, hotel bills, and extra expenses in wet towns, cost the manufacturers a lot of money. If manufacturers really want to economize in overhead charges then the thing to do is to stand for one national road congress, one, just one and no more.

* * *

## Missouri Counties Favor Bonds

Pettis, Saline, and Linn are three counties in north central Missouri where bond issues for road improvement are a live issue this winter. Thomas A. Stanley, of Sedalia, highway engineer of Pettis County, favors a special election to vote on the question of a $500,000 bond issue for that county, while in Saline County there is a movement favoring a bond issue of $1,310,000 to build 192 miles of macadam road.

Clay County, lying to the northeast of Kansas City, has a plan under consideration involving a $1,200,000 bond issue which has recently been referred to representatives from all of the various townships. The tentative system of 180 miles of road laid out, provides that every farmer in the county will be within two miles of a macadam road.

At a recent meeting held in Butler, a movement was started for an $800,000 bond issue for Bates County to build a 200-mile system of roads. As Bates County is under township organization, the question was raised as to the power of the county to issue bonds for this purpose, and the matter was referred to the attorney-general for opinion.

## Big Bond Issue a Live Proposition in Kane Co., Illinois

Next to Vermilion and Cook counties, in which bond issues of $1,500,000 and $2,000,000 were voted more than a year ago, the greatest progress in Illinois towards a speedy solution of the mud problem is being made in Kane County.

Kane County lies about forty miles west of Chicago and contains two good-sized towns, Elgin and Aurora, where the sentiment for good roads is strong. Those in favor of improving all of the main routes of travel throughout the county within the space of a few years, rather than waiting for the slow process of State aid, have been hard at work for the past year, and their efforts were rewarded on December 15 when the county board, by a vote of 23 to 14, adopted a resolution providing for submitting a $1,500,000 bond issue to a referendum vote.

Good roads will not be an entirely new departure in Kane County, which has been active during the past two years in building roads under State aid. One of the first stretches of concrete pavement on the Lincoln Highway in Illinois was built near Aurora in the southern part of the county early in the summer of 1914.

George N. Lamb, Geneva, Ill., is county superintendent of highways of Kane County.

* * *

At the Sixth Annual Meeting of the Motor Truck Club of America, Incorporated, held at the club headquarters, 1790 Broadway, New York City, the following officers were elected to serve during the present year:

President, T. D. Pratt.
First Vice President, Roderick Stephens.
Second Vice President, David C. Fenner.
Third Vice President, Haywood P. Cavarly.
Treasurer, Nat. Mallouf.
Secretary, Ellis L. Howland.
Directors, George H. Pride, Joseph K. Orr, Emanuel Lascarus, Elmer B. Clark, and A. J. Slade.

The following members were also elected to the Nominating Committee for 1916: Roderick Stephens, chairman; D. C. Fenner, George H. Duck, T. D. Pratt, and Charles W. Fletcher.

The year just closed has been a successful one for the club, with a large increase in the membership, and the new year opens with the club in excellent financial condition. Meetings are held monthly, and much good has been derived from these meetings, which are always preceded by a club dinner. These meetings will be continued this year, the first one having been held on Wednesday evening, January 19, at the Automobile Club of America.

* * *

## Important Road Improvement in Cuba

**Consul P. Merrill Griffith, Santiago de Cuba, December 9.**

Considerable interest is manifested here by many prominent citizens in the construction of a public road between Santiago de Cuba and Guantanamo. The distance represented by the proposed route is about sixty miles, and the work as far as Moron has already been completed, that portion from Santiago de Cuba to Cristo being in excellent condition. It was built during the American intervention.

Work is now going on in the vicinity of Moron, and in order, if possible, to secure a additional appropriation from the Federal Government through the present Congress, a mass meeting was held at La Maya on November 30. It was attended by more than 1,000 persons, special delegates being sent by all the municipalities along the proposed route.

The remainder of the distance from Moron to Guantanamo is through a mountainous section of the country, and it is stated that the cost of construction will amount to about $15,000 per mile.

It is hoped that the enterprise may be successfully carried out, inasmuch as it would prove of inestimable value to the commercial and industrial interests of this section of the island. The president of the executive committee elected at the mass meeting is Mr. Luis Hechavarria, whose address is Santiago de Cuba.—*Commerce Reports, Dec.* 31, 1915.

* * *

All of the division, or assistant, engineers of the Pennsylvania State Highway Department were recently called into the offices of the department at Harrisburg, Pa., for a general conference. Meetings were held morning, afternoon, and

evening for the first four days of the week, and conditions, needs, etc., under the existing conditions in all of the then fourteen divisions were taken up and discussed. The meetings were conducted by Chief Engineer W. D. Uhler and deputy commissioners George H. Biles and Joseph W. Hunter. The last two days of the week were devoted to an inspection trip over several hundred miles of roads of all types in eastern Pennsylvania, where road construction and maintenance has reached a higher degree of perfection than in other parts of the State. This was the first meeting of the kind that has been held by the department, and the division engineers unanimously stated to the writer, who accompanied the party, that it was, without question, the most valuable and the most instructive meeting they had ever attended, and that more real benefit was obtained than could have been secured in any other way. These meetings will be continued by Chief Engineer Uhler at such intervals as may be necessary. Another meeting was held in January at Harrisburg, mention of which will be found on another page of this issue.

* * *

Manufacturers who were solicited to contribute money to make possible the holding of the joint road congress held at Oakland, California, were given to understand that they would not be requested to contribute money, or buy exhibits, or spend money to attend another national road congress in 1916, and as evidence of their good faith in the matter the directors of the American Highway Association have gone on record as follows:

RESOLUTIONS PASSED BY THE BOARD OF DIRECTORS OF THE AMERICAN HIGHWAY ASSOCIATION AT A SPECIAL MEETING HELD IN WASHINGTON, D. C., JANUARY 12, 1916.

*RESOLVED,* That in view of the understanding very definitely reached prior to the Pan-American Road Congress at Oakland, California, in September, 1915, that there would be no other national road meeting during the succeeding twelve months, the American Highway Association feels that in good faith to all interested in the good roads movement it cannot accept the invitation of the American Road Builders' Association to participate in its proposed congress of February-March, 1916.

*RESOLVED further,* That this Association expresses its entire sympathy with the plans and purposes of the American Association of State Highway Officials as outlined in their resolution of December 8, 1915, and will lend all its efforts to the successful carrying out of that plan. With that end in view it is the purpose of the American Highway Association to cooperate with the American Association of State Highway Officials in its proposed joint congress to be held in December, 1916, or at a later date.

* * *

William H. Connell, for the past four years chief of the Bureau of Highways and Street Cleaning, Philadelphia, Pa., has been re-appointed to the same position under the new city administration. The re-appointment was made absolutely on merit, as a personal inspection of Philadelphia city streets and country roads was made by Mayor Smith and Director Datesman, of the Department of Public Works, before the re-appointment of Chief Connell was decided upon. The streets and roads were found to be in such excellent condition and so economically maintained that the decision to continue Mr. Connell at the head of the Bureau of Highways was mutually decided upon by the mayor and the director.

Mr. Connell is thirty-eight years old, and has been engaged in engineering work for the past eighteen years. Prior to his assuming charge of the Bureau of Highways in Philadelphia, four years ago, he was for three years engaged in the re-organization of the Bureau and in charge of highway work in the Borough of the Bronx, New York City. In 1910, he built the famous White Plains., N. Y., road as an experimental service test roadway, which has given highway engineers much valuable data and information. He later built a similar service test roadway in Philadelphia, on which careful cost data is being kept.

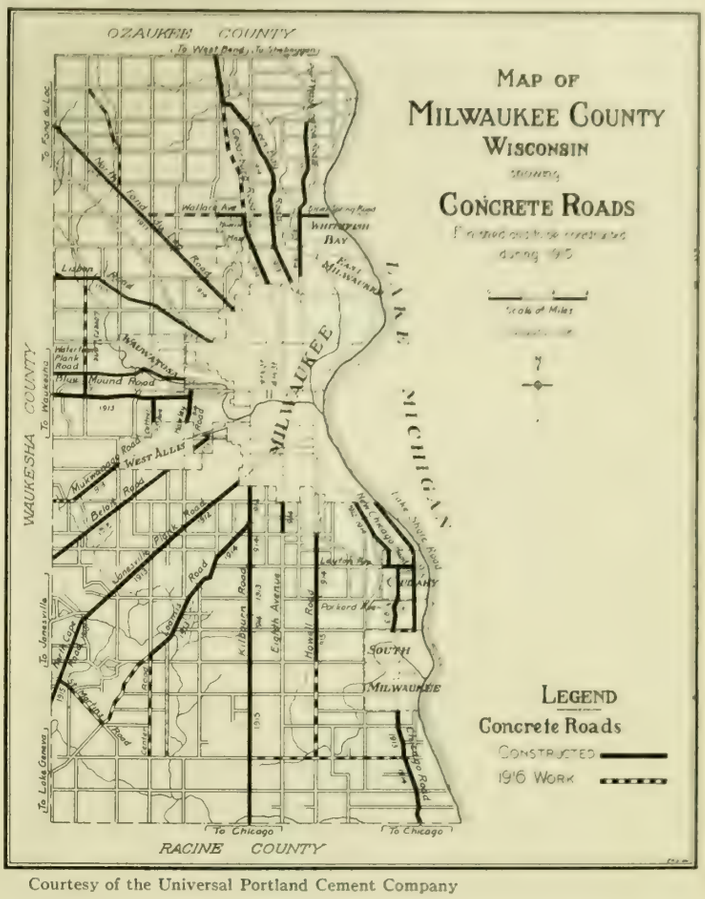
During the past four years, Mr. Connell developed and installed a modern cost system in the Bureau of Highways of Philadelphia that is simple and second to none employed in any other city in the country.

Mr. Connell is a member of the American Society of Civil Engineers, a director in the American Road Builders' Association, a member of the American Highway Association, past president of the Philadelphia Society of Municipal Engineers, and a member of the Engineers' Club of Philadelphia.

* * *

## 1916 Program of Milwaukee County, Wisconsin

Milwaukee County's 1916 highway improvement program involves the building of about thirty-five miles of highways, as




Courtesy of the Universal Portland Cement Company

usual, sixteen feet wide or greater. All but one of the stretches are to be of concrete; Washington Boulevard of sheet asphalt. Milwaukee County now has about 100 miles of improved roads, mostly concrete, but with a few stretches of sheet asphalt and brick.

* * *

## Give Them the Vote

(No, we're not talking about woman suffrage.)

The lot of the head of a department of street cleaning ordinarily leaves much to be desired. Almost always a political position (meaning appointive rather than civil service) the commissioner or superintendent is invariably expected to keep the streets cleaner than the last incumbent, and at a less cost.

Sure! That's easy. Just reorganize the department, buy a lot of labor saving machinery and the trick is done.

Not quite.

Reorganization of a department, putting it on a business basis, reducing waste effort and, in general, plugging up all of the leaks probably is possible in many cases. But the same old men—old in more ways than one—the broom pushers—remain. It looks as though they always *would* remain.

The commissioner seldom has the power to select the street sweepers—by far the largest part of his organization; he must appoint all of the ancient and infirm males the civil service commission sees fit to certify.

As a method of pensioning aged and decrepit citizens the system has no equal. We favor it, as a duty of the municipality, being far preferable to sending them to the poor house as it preserves their self-respect and has other advantages.

BUT THE SALARIES SHOULD COME OUT OF THE CHARITY FUND RATHER THAN OUT OF THE FUNDS OF THE STREET CLEANING DEPARTMENT.

In this event some funds would be left over with which to buy labor—and money-saving street cleaning machines, which are sorely needed in almost every city that has come under our observation.

The purchase of a sufficient number of any of the standard types of street flushers, sweepers, squeeges, etc., would go a long way towards solving the street cleaning problem.

As a mechanical proposition the machine has it "all over" hand methods. But it has one insuperable disadvantage.

It can't vote.

* * *

## Second National Conference on Concrete Road Building

The plans of the forthcoming Second National Conference on Concrete Road Building, to be held in the Auditorium Hotel, Chicago, February 15-18, have been completed and highway engineers and road experts in all sections of the country are looking forward to a successful conference exceeding in general interest the initial meeting of a year ago. Acceptances on the part of prominent men who have been asked to address the conference, insure features of unusual interest aside from the important technical work that will be embodied in the reports of the various sub-committees.

This year, an address of unusual interest will be given by Major Amos A. Fries, of the United States Army. He will discuss "The Military Value of Permanent Roads," a live and interesting topic having to do with national preparedness and of interest to all classes of people. Other speakers of prominence will present various phases of the highway question.

The real work of the conference as it concerns improved methods of construction will develop through the reports of the several sub-committees, of which there are seventeen in all. The chairmen of these committees include highway engineers, educators, and highway officials of national prominence. The subjects or committee reports will cover every detail of concrete highway construction from drainage and the preparation of subgrade to finishing and curing. Economical widths of pavements, problems of design, mixing and placing, proportions and aggregates, and organization of crews, will all be considered and supplemented with reports relating to construction and maintenance costs, specifications, inspection problems, and like topics. The membership of the sub-committees, taken altogether, comprises more than eighty men who have had wide experience in the construction of concrete highways.

Notwithstanding the general success attending the construction of concrete roads, there still exists diversity of opinion concerning minor details, and these will be threshed out to the ultimate advantage of the engineers and contractors especially interested in this type of highway. For example, it is anticipated that unusually interesting discussion will take place when the subject of joints is presented, as it is well known that some experienced engineers advocate dispensing with them entirely while others have pronounced views in the opposite direction.

The various committees have been busily engaged during the past twelve months and matters have now reached the point where it can be definitely stated that the success of the conference is assured.

* * *

## Springfield, Ill., Engineers' Club

The Springfield, Ill., Engineers' Club has just passed its first birthday, and has developed into quite a vigorous youngster. The active membership now numbers 132, and is expected to increase to over 175 within a short time—quite a number for a city of the size of Springfield.

At the recent annual meeting, Clifford Older, bridge engineer of the Illinois State Highway Department, was re-elected president. Mr. Older is a graduate of the University of Wisconsin, class of 1900, and has been with the State Highway Department since 1906. Previous to this connection, he was engaged in railroad work with the Pennsylvania and Chicago and Alton railroads.

H. B. Lewis, of the Central Union Tel. Co., was elected secretary.

* * *

One thousand miles of perfect roadway have been constructed by Colorado convicts in the past seven years. Colorado began to employ convicts on the roads in 1908. At first armed guards were used, but during the second summer the honor system was introduced, and it is still in vogue.

In 1915, the road operations were more extensive than ever, according to the report received by the National Committee on Prisons and Prison Labor from Warden Tynan to whose enthusiastic effort is due the success of the work.

Warden Tynan states that the convicts are working on five separate and distinct roads, and will remain at work all winter, as in Colorado they can operate the camps during the whole twelve months of the year.

"One of the most wonderful roads ever constructed in America has just been completed," Warden Tynan says, "after two years of blasting solid granite for eighteen miles along the Arkansas River. This opens up a splendid automobile highway from Kansas, up the Arkansas River to its source, over the "Continental Divide," and to the Utah line.

"We have still another gang of men working in the Eagle River canyon on this same route, and they have four years' work ahead of them. We are operating large power drills and steam shovels in our mountain work and heavy gasoline tractors and other machinery in our prairie camps."

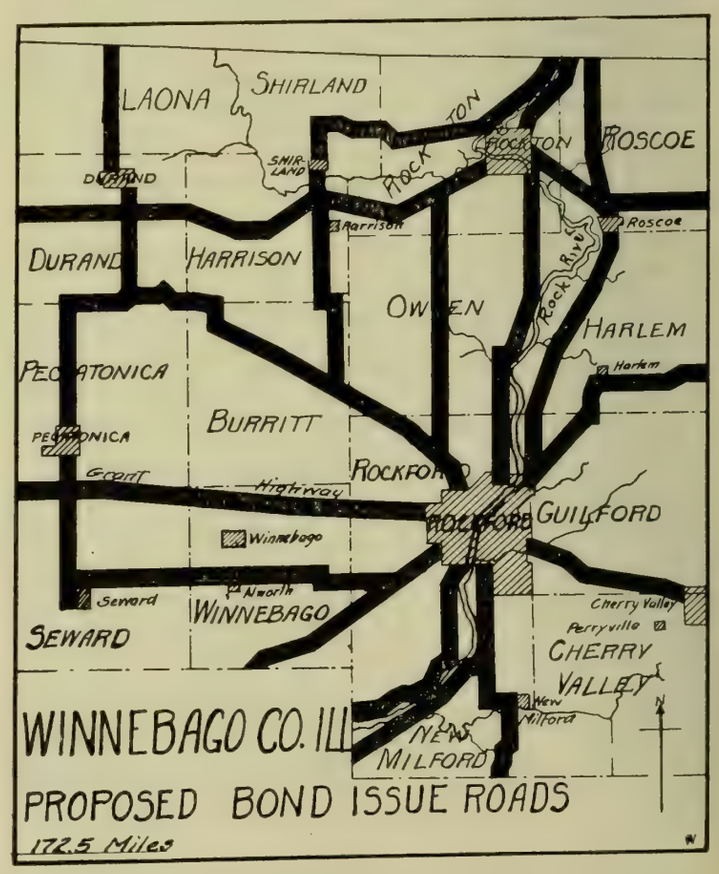
Colorado convicts, in addition to the work, form three large ranches, and next year a fourth ranch is to be added. From 50 to 60 per cent. of the able-bodied prisoners are employed out of doors, and Warden Tynan sets forth that the success with them is better than ever.

* * *

## Winnebago County, Illinois, Waking Up

THOUGH the movement has not progressed to the point of definitely deciding on an election, there is quite a strong agitation in Winnebago County, Ill., in favor of a large bond issue.

Several plans have been advanced, one by Herbert S. Hicks, which contemplates improving the system of roads shown on

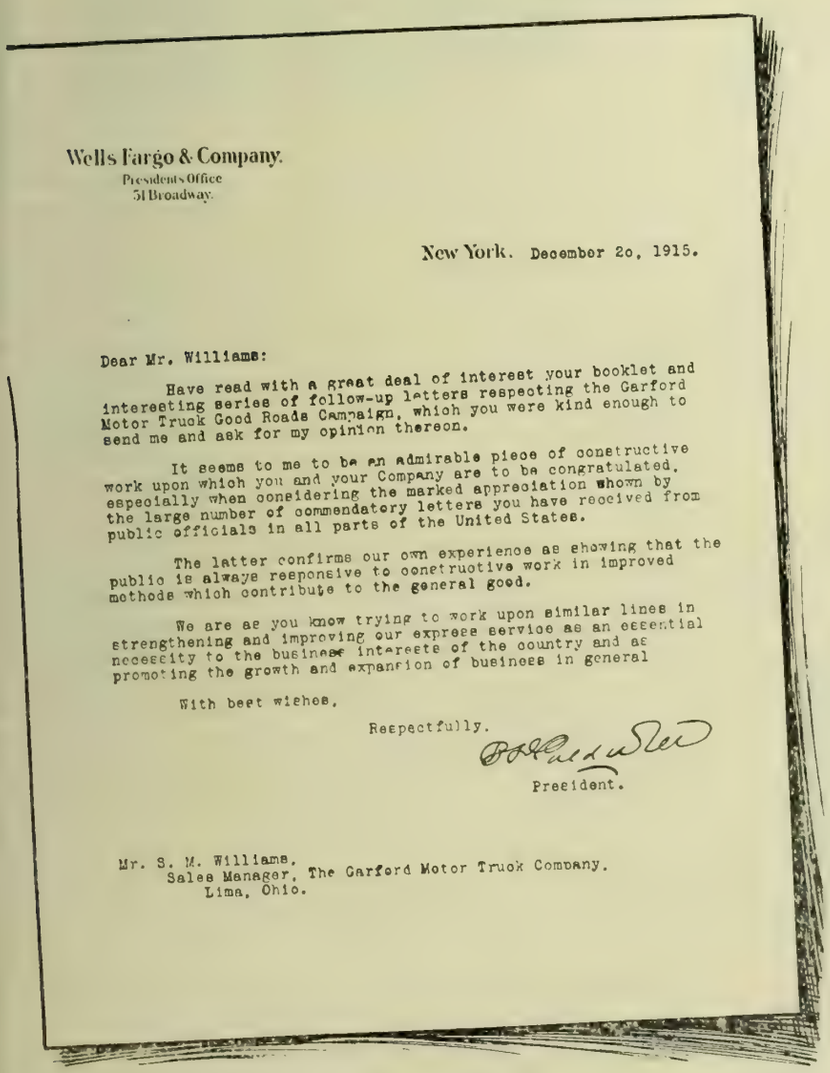



the accompanying map, 172½ miles long, by means of a $1,500,000, 4 per cent. bond issue. An article by Mr. Hicks in the

# Garford MOTOR TRUCKS.

¾, 1, 1½, 2, 3, 5 and 6 ton capacity

## Good Roads and Better Business



Wells Fargo & Company.
President's Office
51 Broadway.

New York. December 2o, 1915.

Dear Mr. Williams:

Have read with a great deal of interest your booklet and interesting series of follow-up letters respecting the Garford Motor Truck Good Roads Campaign, which you were kind enough to send me and ask for my opinion thereon.

It seems to me to be an admirable piece of constructive work upon which you and your Company are to be congratulated, especially when considering the marked appreciation shown by the large number of commendatory letters you have received from public officials in all parts of the United States.

The latter confirms our own experience as showing that the public is always responsive to constructive work in improved methods which contribute to the general good.

We are as you know trying to work upon similar lines in strengthening and improving our express service as an essential necessity to the business interests of the country and as promoting the growth and expansion of business in general

With best wishes,

Respectfully.

B. D. Caldwell

President.

Mr. S. M. Williams,
Sales Manager, The Garford Motor Truck Company.
Lima, Ohio.

The Garford Motor Truck Company early appreciated that the growth of its business depended largely on the expansion of business in general.

We also appreciated the fact that no single factor so directly contributes to the prosperity of every community and its business interests, as good roads.

A national investigation of road conditions led us to solicit the co-operation of leading automobile manufacturers in a broad campaign to crystalize public sentiment in favor of a universal improvement in the condition of public highways.

We did not secure co-operation.

Consequently the Garford Motor Truck Company undertook this herculean task **absolutely unaided.**

After months of work in the compilation of lists and the preparation of material, we distributed some twenty thousand copies of our book "Roads — Their Influence Upon Economic and Social Conditions"—among state and county officials, engineers, prominent business men and educators.

Since then requests have been received from Good Roads Associations, Chambers of Commerce and influential men for over **250,000 copies of this booklet** for use in Good Roads Campaigns in all sections of the country.

The letter from Mr. B. D. Caldwell, president of the Wells-Fargo Company, is typical of the many expressions received from business men.

We ask your co-operation in this work which so vitally affects the welfare of every individual. Your copy of our booklet will be mailed free upon request. Please address Dept. 100.

## The Garford Motor Truck Company, Lima, Ohio

**Distributors and Service Stations**

New York, Boston, Philadelphia, Baltimore, Pittsburgh, Chicago, Minneapolis, St. Louis,
Kansas City, Denver, El Paso, Dallas, Houston, San Francisco, Columbus, Cincinnati, Indianapolis.

Rockford *Star* several weeks ago gave a number of interesting tables showing the amount of taxes required by such a bond issue and the returns which each township would receive.

One of the tables is given herewith, showing the necessary payments based on placing $500,000 of the bonds on the market each year for three years. Winnebago is a typical agricultural county, though Rockford, the county seat, has a population of nearly 50,000.

The first column shows the total payments of principal and interest which would accrue each year, and the second column the direct tax on each $100 assessed valuation which would be required to meet the payments.

By striking a general average over the twenty-year period, the average annual payment is $103,500 and the average annual tax rate $0.294 per $100 assessed valuation. With the State paying half the bill, the tax rate would amount to about 15 cents per $100 assessed valuation.

Further figures show that the city of Rockford would pay 63 per cent. of the entire tax, and the remainder of the county 37 per cent. However, if the actions of other counties, similarly situated, can be taken as a criterion, there will be no opposition on the part of the city people to a bond issue on such a basis.

The tax on rural inhabitants is relatively light. According to the decision of the State Board of Equalization, farm lands in Winnebago County are assessed at the rate of $26.58 per acre. On the basis of a 15-cent tax levy each acre would pay an annual tax of $0.0398—a little less than four cents per acre.

At this rate, the average farmer owning a quarter section of land would not have to pay over $6.40 per annum toward this county-wide system of highways.

Another tentative plan, contemplating a slightly larger bond issue, favors the improvement of 186 miles of road as follows:

| *Type* | *Miles* | *Unit Price* | *Total Cost* |
|---|---|---|---|
| Concrete | 92 | $15,000 | $1,380,000 |
| Old Macadam rebuilt with Bituminous Top | 18 | 5,000 | 90,000 |
| Waterbound Macadam | 40 | 7,000 | 280,000 |
| Oiled Earth | 36 | 2,000 | 72,000 |
| Total | 186 | ..... | $1,822,000 |

A. R. Carter, Rockford, Ill., is county superintendent of Winnebago County.

* * *

## Philadelphia's Highways are in Fine Shape

PHILADELPHIA, third largest city in the United States, is attracting much attention and favorable comment over the most excellent condition of her streets and country highways. This city is different from other cities in the fact that the city of Philadelphia includes all of Philadelphia, the city being one of the sixty-seven counties of the State. The highway work, however, both as regards city streets and pavements and the country roads and pavements, is all under the direction of the Department of Public Works, Bureau of Highways, William H. Connell being the head of the latter bureau. And although Mr. Connell has been in charge of the highway work of the city, and took hold when the streets and roads were generally in notoriously bad condition, in four years he has so improved them that Philadelphia, without question, leads all other cities in the excellent condition of her thoroughfares. Some idea of the magnitude of the work that is incident to keeping the streets and roads of Philadelphia in repair may be gained from the fact that, on January 1, 1916, there were a total of 1,669.68 miles of streets and roads within the city limits. This is a greater mileage than is included in the entire State highway systems and Maryland and many other States. During 1915, there were 140 miles of new streets and roads constructed and 1,874,000 square yards of road were treated. In addition to the construction, maintenance, and repair of the highways, the Bureau of Highways in Philadelphia also has charge of 1,337 miles of sewers and 301 bridges. The total amount expended by the bureau in 1915 was $8,826,000, and during the past four years, Chief Connell has expended through his bureau a little over $21,000,000. The bureau also has charge of snow removal, street cleaning and ash, rubbish, and garbage removal. It is therefore one of the busiest highway departments in the entire country.

As has already been stated, the main and all connecting highways are this year in better shape than they ever have been before. This, Chief Connell states, is due to maintenance, as this is unquestionably the main factor in assuring the continuance of good roads conditions, after the highway has once been constructed, whether the highway is in Philadelphia or in any other section of the country.

Under the Blankenburg administration, which went out of office with the inauguration of Mayor Smith the first week in January, hundreds of miles of the finest macadam and bituminous surfaced roads have been built, and these have been standing up so well, owing to the modern and careful methods of construction employed, and to the maintenance that has been placed on them as soon as they were completed, that they have become the talk and the envy of municipal engineers in almost all of the large cities of the country. Scores of these engineers have visited Philadelphia during the past few months to see for themselves just what conditions the roads are in, as it is known nation-wide that the maintenance costs have been low, and that for several years these costs have been materially reduced each year as compared with the costs for the previous year.

In speaking of the condition of his roads, Chief Connell made the following most significant remark: "The only way for taxpayers to insure that the money invested in the construction of a good road or pavement will be a good investment is to see to it that proper provisions are made for the maintenance." Chief Connell places maintenance immediately after proper construction, as being of the highest importance in assuring good roads and roads that are year after year in good condition without the necessity of resurfacing or the expenditure of large sums for extensive repairs. This winter he instructed all of the division and district engineers of the highway bureau to make a special study of maintenance and maintenance requirements, and to in every case promptly have repairs made as soon as they are needed, all through the winter months, when road building is necessarily suspended on account of weather conditions. This is the only sure way of keeping the road in good condition and saving the taxpayers money.

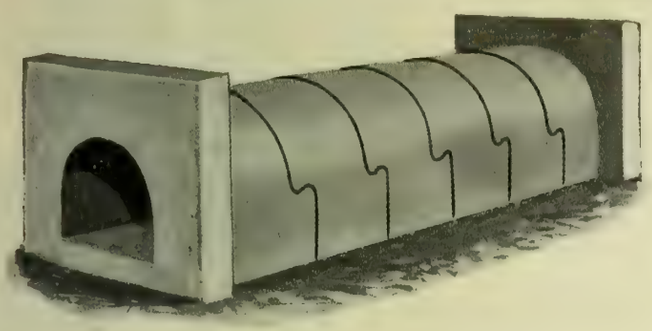
As a practical demonstration of the splendid condition of the main traveled thoroughfares of the city of Philadelphia, Chief Connell stated early in January that a traffic census taken in the city last fall shows that there are approximately, four times as many automobiles using the main thoroughfares as there were a year ago. The maintenance problem, therefore, he says, looms up as of the highest importance. He has impressed this fact upon his division engineers, and this winter they are all studying maintenance. In maintenance, he says, the principle of "a stitch in time saves nine" should be adhered to.

"If we wish to continue the reputation that the city has achieved for our good roads, this principle must at all times be kept in mind, as the main consideration of the highway problem is the upkeep." This latter argument, Chief Connell has time after time presented to Philadelphia councils in urging that they make more liberal appropriations for street and road pavement maintenance. Road engineers through the entire country are a unit on this phase of the building and maintenance of highways, and in support of this, Mr. Connell quoted President Benjamin Ide Wheeler, of the University of California, who declared that "in planning a system of roads, the first thing is to plan for keeping them in repair." President Wheeler states that it is no great trick to build roads, but he states that it is simply pitiful to see the miles and miles of roadway in every part of the country which are steadily and

# Are You Guilty?

## Have You Been Wasting Money and Energy?
## Have you been building culverts by

1.—Using metal or tile pipes and building massive headwalls at the ends, thus placing a Permanent Coping upon Temporary Pipe?
2.—Using "wrinkled tin" pipes as forms, pouring grout around them, thus making a triple cost for materials?
3.—Using wood or metal forms for monolithic construction, thereby losing half the money on haulage, and on wasted time, labor, materials?
No doubt you did the best you could, using the best methods at your command. Here's a chance to get in line on a new and profitable way of placing reinforced concrete culverts. There is a Certain, Positive Profit in the manufacture of the Hall Interlocking Concrete Culverts under our exclusive contract.



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rapidly going into decadence for lack of proper upkeep. He was also quoted as having said that, compared with the capitalized cost of annual upkeep and repair, the initial cost of road construction is comparatively slight.

"It is useless," he stated, "to say that the roads can be so thoroughly and well constructed that repairs will be inconsiderable. We know that this is not so. The excellent roads of France and Germany, and those of England, are maintained by patient, consistent, and continuous work of maintenance and repairs. Whenever a slight depression appears on the surface of a road, it should be immediately attacked and cut out like a cancer. If we are to have really good highways, our method of repair must be much more prompt and careful than it has been in the past. The problem of road building is a problem of repairing.."

Emphasizing the value of vigilant maintenance, Chief Connell in his instructions to his assistant engineers has said: "If you try to impress on all those under your jurisdiction that they should give the problems of maintenance the attention that they would if they had to pay the bills, or additional costs for the care of the roads due to any neglect on their part, I am sure that Philadelphia will come up smiling in the spring with a system of highways to be proud of, and the roads and pavements of the city will be a credit to the city as well as to the department."

On another page will be found an article taking up in detail the work that has been done in Philadelphia during the year 1915, together with methods employed, savings that were made, and how these were made. In this other article, it will be shown that in the bituminous surface treatment of the country roads in Philadelphia, a reduction of 1.57 cents per square yard was possible through the improved methods that were employed, this saving alone on the 1,874,014 square yards treated amounting to the sum of $29,400.00, as compared with the unit costs in 1914. In this and subsequent articles, additional most interesting and instructive data will be presented.

## Pave Your Alley

By Mac

A big convention of men who ought to know, recently decided that alleys in residence sections of a town were not necessary. But there are many who would disagree with this profound judgment.

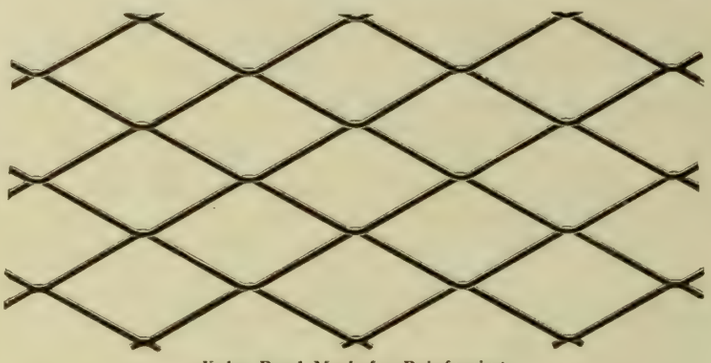
They "just can't get along without an alley," and they bring up quite a number of good arguments for this "Ishmael" of the streets. But when you have analyzed all their needs, you just find that they want an alley for dirty work. They want their street clean and the yard clean, even the back yard clean, but about the alley they are not so particular. Of course,



they don't say this, but "actions speak louder than words," and your eyes and nose find it out when you visit their alley.

*The alley should be as clean as the street,* and if it were paved it would be! You wouldn't for one minute "stand for" the dirt that is now in your alley if it were paved. "Dirt is only matter out of place," and it does not *look* so bad in an unpaved alley as it does in one that is paved. Dirt has no more right in an alley than in a street or yard. It is out of

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Kahn Road Mesh for Reinforcing

## Kahn Mesh

Provides the ideal reinforcement, so necessary to a perfect Concrete road.

Manufactured from one piece metal sheets it assures the engineer or contractor, rigid reinforcement that cannot be jarred from its position by pourings.

Shipped in flat sheets, it does away with the unrolling of coils, cutting to size and holding in position.

Owing to its being one piece of metal it assures a perfect bond between members and between steel and concrete.

## Kahn Armor Plates with Beveled Edge

Positively prevent the pavement from chipping or cracking at the joints,

Manufactured from a soft, open hearth steel, it is tempered to the exact hardness to allow it to wear down perfectly with the pavement, while its beveled construction and split end bars provide a positive anchorage.



Kahn Armor Plates, note bevel edge construction

*Send for folders, describing Kahn Mesh, Kahn Armor Plates, Kahn Curb Bars and Edge Protectors, Kahn Installing Device for Expansion Joint Construction and Trus-Con Side Forms.*

KAHN Building Products TRUSSED CONCRETE STEEL CO

*Trussed Concrete Steel Company*

Department A-37 YOUNGSTOWN, OHIO


place, some of it should be in the dump and some of it on the fields as fertilizer.

Here 's a picture of a typical alley. The street is paved with concrete in this instance, the boulevards are grassed, the sidewalks are of cement, the front yards and the back yards are clean; but the alley—! It has never received *any* attention! And yet here comes the mail carrier. It is of the greatest convenience to him as a "shortcut" on his rounds—not so bad in dry weather, but what must it be during rains!

The cost to each owner for paving an alley is small. If the alley is paved, owners need not build driveways, for the alley gives a good entrance to the lot and easy access to the garage or barn, and the space saved is worth a great deal for lawn or garden.

Pave your alley! Then it is easy to keep it clean, and when clean the menace of disease is absent.

* * *

## What Was Done in Kentucky in 1915

THE State aid road proposition the first year of its experiment has proven an immense enterprise, involving the expenditure already under contract of approximately $747,519 for the State's part of the road construction, to which the counties put up an equal amount. Besides the amount furnished by the 5-cent State tax, estimated at $537,293.42, and $210,215.58 in the motor license fund July 1, and an equal amount raised by the counties by direct taxation, fourteen counties have issued $2,215,000 in road bonds. The State will expend an equal amount with these bonded counties in road construction, but the amount appropriated to them in any one year will be within the two per cent. limit, the apportionment continuing until the State has paid its half.

Commissioner of Roads R. C. Terrell has issued a statement, setting forth the source and extent of the State road funds and how they are expended. His statement follows:

WHERE MONEY COMES FROM.

"The revenue for State Road Fund is derived from two sources, namely, the license tax on automobiles and the 5-cent levy direct State tax on all classes of property for road purposes.

"In 1910 the General Assembly passed a law requiring all automobiles to be registered and license fee for same to be paid into the automobile desk in the Secretary of State's office. Said license fee to be a part of the State Road Fund for the purpose of constructing and maintaining public roads, although no provision was made for spending any part of this fund until 1912.



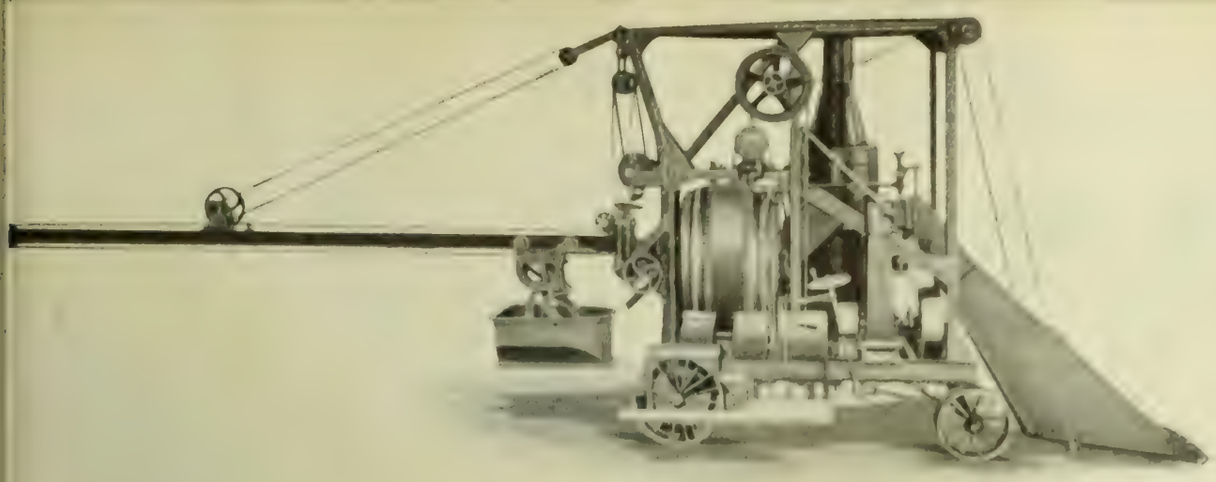
Concrete Road, Kenton County

"There accrued from this source from June 22, 1910, to July 1, 1912, $54,610.80, and charged against this sum for collection of same $5,207.01.

OVERHEAD EXPENSES.

"The General Assembly of 1912 created a Department of Public Roads and set aside $25,000 annually, or such a part of said amount as was necessary to run the Department.

"From July 1, 1912, until June 30, 1913, inclusive, the collections from motor license fund was $54,877.80. The running expenses of the Department of the Public Roads for the same time was $10,064.01, and the fee of collecting motor license $2,909.70, including cost of tags.



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W. W. Williams.

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Our line of contractors' equipment consists of a full and complete line of machinery such as concrete mixers, excavating graders, heavy-duty motor trucks, power pumps, steam and gasoline hoists, material elevators, saw rigs, brick conveyors, wheel and drag scrapers, wheelbarrows, etc., in all of which we live to the lines of our motto and slogan: "Everything for the contractor," "The best of its kind."

Some of these lines, and those we recognize as our leaders, we will show at the Coliseum in Chicago during the Cement Show from February 12 to 19; we invite you to meet us on this occasion; our boys will be there to greet you with the glad hand and show you through our line, that you may carefully inspect the very latest models of the celebrated Koehring Concrete Mixer, six hundred of which are now in service in Ohio alone, and also the last word in heavy-duty and properly equipped motor trucks for your service. The Sternburg Motor Truck, fifty of which, in the seven-ton units, have during 1915 been adopted by your brethren in Ohio alone. At the Cement Show you will have the opportunity to compare values. This we enjoy having our customers practice, for our lines will stand the acid test.

Should it not be convenient for you to be at Chicago, please bear us in mind when in need of equipment. We are at your service before and after purchases are made. We feel that your interests and ours are mutual. We will not misfit you. We know our business, and aim always to satisfy our customers. Try us and be convinced.

Sincerely your,

W. W. WILLIAMS.



Sternberg Heavy Duty Truck.



W. S. W[illegible]



C. A. Elliott.



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D. H. Chappelier.

"HARRIS PAVERS"
Daily Capacity 40,000
THE HARRIS BRICK COMPANY
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Asphalt Products for Road Building are Unsurpassed
Road Binders, Asphaltic Cements, Road Oil
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"McAVOY BLOCK"

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Consulting Highway Engineer
Broadway and 117th Street New York City

From July 7, 1913, to July 1, 1914, there was turned to the road fund from the motor license fund $61,363.56, and the cost of the running of the State Department of Public Roads was $15,509.42, and the cost of collection of motor license fees $5,111.91.

"From July 1, 1914, to July 1, 1915, there was collected $118,874.27 from the motor license fund and expended by the State Department of Public Roads $24,992.85, and for collection of motor license fees $15,653.58, leaving remaining to the credit of the road fund on July 1, 1915, from the motor license fees alone $210,215.58.

"The law providing for a State system of public roads consisting of intercounty seat highways of all the counties of the Commonwealth was put into effect immediately after the first of January, 1915, and counties were asked to make application for State aid. One hundred and four counties applied, but for some reason or another fourteen of them failed to have prepared the necessary plans, specifications, and estimates of cost of the work and consequently only ninety counties are now actively engaged in the construction of 800 miles of road, which varies in type from a well-crowned and graded earth road on which a split log drag is used for maintenance to and including gravel, macadam, bituminous surface treatment, bituminous concrete, cement concrete, and brick. The width of surfacing varies from nine feet for single-track roads on road beds crowned twenty feet between ditches to as much as eighteen feet of surfacing material on road beds graded to twenty-four feet between ditches.

"This work has been financed by the counties according to the law until the completion of the work, the State paying one-half the cost of actual construction and supervision upon completion of same.

SOURCE OF REVENUE.

"The apportionment to these counties for the work is based upon the amount of money which accrued to the road fund from the motor license fund and the 5-cent tax on property, which is divided as follows:

| | |
|---|---|
| "Sheriff's revenue on $887,141,119, at 5c on each $100 | $443,570.00 |
| "Tax on distilled spirits (estimated) | 3,500.00 |
| "Tax on miscellaneous corporations (estimated) | 17,923.00 |
| "Railroad franchises (estimated) | 42,155.00 |
| "State banks (estimated) | 8,550.00 |
| "Tax on railroads (estimated) | 35,140.00 |
| "Tax on National Banks (estimated) | 7,681.00 |
| "Motor license fund on hand July 1, 1915 | 210,215.58 |
| "Estimated total of all road funds, 1915 | 768,734.58 |

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I am interested in your latest design steel. Please send Catalogue and Circular B-2.

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Warrenite hard surface pavement on Terwilliger Road in Multnomah County Portland, Oregon

With this Company, thoroughness is a matter of business policy growing out of our recognition of the demand for the best surface for country roads. A surface of a "quality" standard.

In meeting this demand there is no middle ground upon which a good road surface can be built. Therefore, in 1910 we offered the public such a road surface, namely, "WARRENITE, the Ideal Country Road."

WARRENITE has been laid to the extent of 480 miles of roadway, 16 feet wide, in many counties and States from coast to coast, and has given the counties an ideal surface at a reasonable cost.

After three years' practical test in the use of WARRENITE surface, the Multomah County Court (which county includes and surrounds Portland, Oregon) in June, after a thorough investigation of all substantial forms of road construction, awarded contracts for surfacing of 74 miles (of roadway 16 feet wide) of WARRENITE surface, this being, it is said, the largest country road contract ever let in America. The work is now under construction and it will be an example for other counties to follow.

A report of the Portland Chamber of Commerce special paving Committee, dated June 12, concludes:

. . . "We are certain that everybody concerned in this paving problem who is entirely disinterested, has been, and is now, seeking to get the very best available pavement for the county, because it is realized that, in so doing, the county will be furnishing an object lesson which will be an incentive to depart from the unwise policy of the past, which has resulted in throwing money away for useless macadam roads."

Don't hesitate—investigate for yourself or let us show you the value by surfacing your roads with WARRENITE.

Write to-day for illustrated booklets and learn more about this modern ideal road surface.

WARRENITE specifications and mixture agreement available to all contractors.

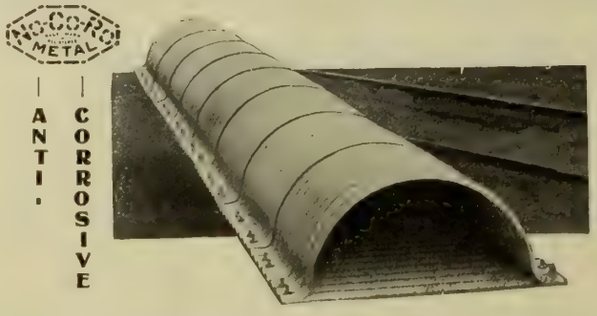
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and an extremely shallow fill must be made as in city streets, the

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Flat Corrugated Bottom Culvert saves the day. It has the strength to stand up under such service conditions, has sufficient resistance to corrosion to be classed as permanent and has the Nestable feature to save on transportation charges unless you prefer them shipped Set-up.

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Highest Efficiency Lowest Operating Cost

Absolutely Automatic on Sand, Screenings, Slag, Stone, Small Coal, or Other Loose Material.

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"From which the following items must be taken:

| | |
|---|---|
| "Four per cent. commission given to sheriffs for collecting $445,570 | $ 17,742.00 |
| "Exonerations granted by county courts (estimated) | 3,473.58 |
| "Total commissions and exonerations | 21,215.58 |
| "Estimated net road fund, 1915 | 747,519.00 |

"(Where the word 'estimated' is used in this statement the figures are based upon the tax collected in the year 1914. The 1915 figures were not available).

BONDED COUNTIES.

"In addition to the amount of money to be put in by the State, the counties put in a like amount or in many instances money in addition to the pro rata part the county may receive, is spent under State supervision. Also fourteen counties have voted bonds as follows:

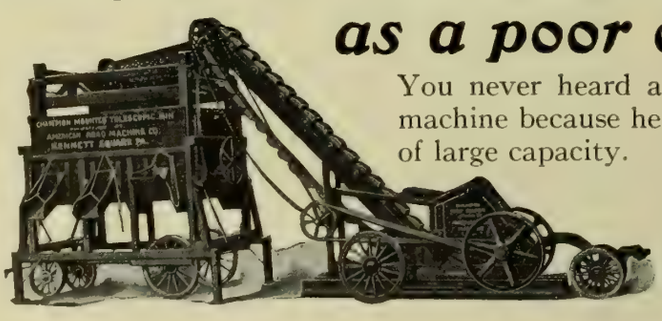
| | |
|---|---|
| Lewis County | $ 150,000 |
| Greenup County | 200,000 |
| Nicholas County | 125,000 |
| Ballard County | 300,000 |
| Bell County | 250,000 |
| Knox County | 200,000 |
| Whitley County | 250,000 |
| Laurel County | 100,000 |
| Rockcastle County | 100,000 |
| Fayette County | 300,000 |
| Carroll County | 50,000 |
| Clinton County | 50,000 |
| Russell County | 40,000 |
| Breathitt County | 150,000 |
| Total | $2,215,000 |

"This money is being expended under State supervision this season. The counties to be reimbursed from year to year as the counties' pro rata parts are available from the State Road Fund until the counties shall have received one-half of the money so spent. Many more counties are preparing to vote bonds during the coming spring.

AUTOMOBILE FUND

"The automobile laws were revised in 1914, and under the present arrangement it is readily seen that collections have been more than 100 per cent. greater than during the year 1913. This is partly due to the more efficient method of collecting and partly to the increase in motor traffic in the State of Kentucky. It is more than likely that for the year 1916 the fund will again approximately double that of 1915, as there has been collected already approximately $26,310.00; three thousand five hundred and eight machines having already been registered for the calendar year 1916. Under the old motor law the machines were required to carry tags with different color lines representing the year in which the tag was issued, but as they merged from one year into another it was impossible to tell by casual inspection whether or not the motorist was running


***It's just as easy to get a good Rock Crusher as a poor one*—and there's more money in it.**



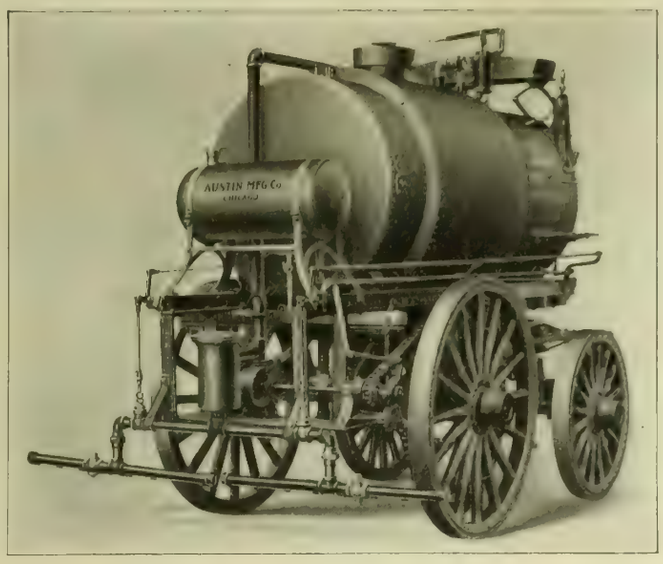
AMERICAN *Champion Rock Crusher, Mounted with Elevator, Screen and Bin*

You never heard a user of a Champion Crusher complain about his machine because he bought a standard crusher, convenient, durable and of large capacity. Made almost entirely of steel, in many different sizes, portable or stationery.

*Our crusher catalogue is an informing book. It's yours if you ask for it.*

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IS MADE in two styles, with heater and without heater. In handling the lighter oils, the efficiency and simplicity of the AUSTIN leaves nothing to be desired and it accomplishes this without the heater attachment. The sprayers can be adjusted to any pressure or any reasonable volume of spread likely to be required in various systems of road treatment.

In spreading oil containing 40% or more asphalt, the AUSTIN distributer, as shown in our illustration, is ideal for the purpose. This heater attachment represents the very latest improvement in that class of device. It has been carefully developed by us for years and is recognized for its superior working and easy operating by many authorities, widely experienced in road oiling. The machine is so well planned that the driver can operate and control its working from his seat; no need of a second man.

*Write for our new catalog on Road Oilers.*

# The Austin-Western Road Machinery Co.

Chicago, Illinois

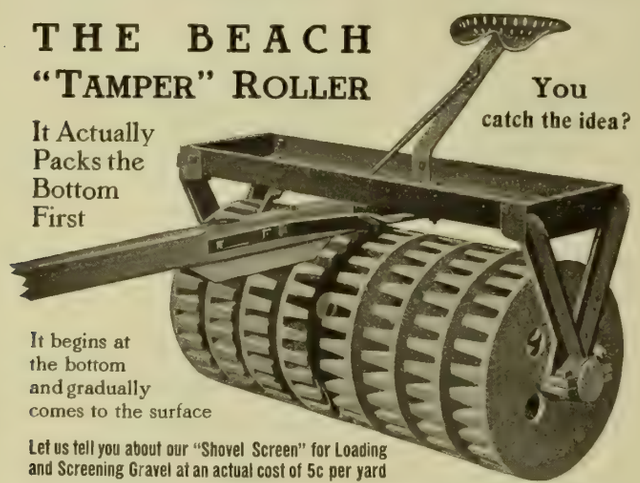
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It Actually Packs the Bottom First

It begins at the bottom and gradually comes to the surface
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Beach Mfg. Co., 30 Beach St., Charlotte, Mich.

OUR WIRE-CUT LUG BRICK is the acme of perfection for street paving material.
Write us for samples and prices.
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TELL 'EM YOU SAW IT HERE.

under an old license, but under the present law requiring tags to be changed, and bearing the year under which they were issued, the motorist being required to pay the pro rata of license for the number of months from date of issue to first of succeeding year, it is impossible for a motorist to run on an old tag, and not be easily detected by the county officials or State officials, whose duty it is to collect the fees.

No motorist who has the interest of the State at heart and who is interested and should be interested in the upbuilding of good roads will attempt to use an old tag as this fee for license is a part of the State road fund and insures a larger percentage of good roads being constructed each year. Besides it is the duty of the county officials to apprehend those violating the motor law of the State and to prosecute the offenders, such offenders being subject to both fine and imprisonment for the violation of said law.

"While three-quarters of the entire numbers of counties are building roads under the State aid law, it is assured that the courts of counties who have not previously applied for State aid will take advantage of the law in 1916, and that the work will go forward with much more ease and rapidity than it has in the last year. While the results obtained during the year 1915 have been eminently satisfactory both to the State and county officials, yet there is no doubt but what the results in 1916 will far surpass those of the present year. People who are especially interested in good roads are requested by the Kentucky Department of Public Roads to lend their assistance in successfully financing the proper construction of the inter-county seat system of highways, and letters containing information and suggestions will be given due consideration by the Department."

* * *

## Fayette County, Kentucky

FAYETTE COUNTY is establishing remarkable records in road improvement and setting a pace which few counties can hope to equal. Efficiency, aggressiveness, and modern equipment have ended a half century of what seems to have been a state of lethargy compared to what has been accomplished in the present era of intensive highway development.

The heart of Kentucky's far-famed blue-grass country, the world's greatest loose-leaf tobacco market, and a section rich in other products, notably thoroughbred horses, all of which Fayette County rightfully boasts, has 385 miles of road and all but five miles have been improved with waterbound macadam.

Improved highways radiate from the city of Lexington to the county seats of all adjoining counties—Winchester, Nicholasville, Versailles, Georgetown, Richmond, and Paris—while the larger distant cities, north, east, and west, are connected by excellent trunk routes. The county embraces about 370 square miles, with one mile of improved road for every square mile of area, a population of about 56,000 with a mile of improved road for every 145 inhabitants.

The achievements of the present administration form an interesting highway romance. Frank A. Bullock, who, as county judge, in 1896, wiped out the old toll roads by purchasing them for $352,000, to-day presides as judge of the fiscal court with all the roads paid for and the county practically out of debt.

Two years ago, when the present county engineer, Robert W. Davis, entered office, the county did not own as much road equipment as a wheelbarrow or a shovel. All county work was then done by contract. Engineer Davis, abolishing a custom almost traditional for fifty years, built up the facilities and the organization necessary for the county to do its own work, designed a centrally located supply station of 400 tons capacity, employing a gravity system in handling material from freight cars to roadway; built liquid asphalt reservoirs to store 24,000 gallons, with steam heating equipment; erected a warehouse for storing machinery, cement, etc., and purchased the following road equipment: one White Good Roads truck for hauling road material and pulling road machinery; one White liquid-asphalt distributor for surface-treating roads, two 4-yard Troy trailers; one elevating grader, one scarifier, two road rollers, two mixers, and a rotary broom.

With this equipment and with an organization of only twenty men, the county reduced the cost of hauling to the re-



No. 40 Flusher—Front View, Flushing in New York City.

# TIFFIN

## Motor Driven Combination Flushers and Sprinklers

### 900 - 1000 - 1200 - 1400 - 1500 Gallon Capacities

To the five models listed above add TIFFIN HORSE DRAWN MOTOR POWER FLUSHERS, and to those add TIFFIN "AUTOMATIC" FLUSHERS, and then add TIFFIN GRAVITY SPRINKLERS, and we think you'll agree that we have a line that in completeness has no rival.

Tiffin Sprinklers and Tiffin "Automatics" have so long been standard in the horse drawn field that comment is superfluous.

But what of the Combination Motor Driven Flushers and Sprinklers—the illustration shows one model at work in New York City cleaning the entire street width at one operation.

These machines are capable of a 250 gallon per minute discharge at 60 pounds pressure.

The motor which supplies the pressure for flushing is in the rear, independent of the vehicle propelling motor—the only system giving constant flushing pressure regardless of truck speed.

The three largest models have six cylinder truck propelling motors, while both motors have self starters—also electric lights.

There are four flushing nozzles, two on each side,—while sprinkling nozzles are interchangeable forward for gravity or power pressure sprinkling.

The tank, flushing motor, and pump can be readily dismantled to allow use of truck for general haulage in the winter months.

Send for our CATALOG about this remarkable line.

### TIFFIN DUMP WAGONS

Do not buy dump wagon equipment without first consulting us on Tiffin "Number Fives." These wagons have scores of features that particularly recommend them, besides being moderately priced. Get our figures.

## THE TIFFIN WAGON COMPANY

### TIFFIN, OHIO

**REPRESENTATIVES**

J. A. delSolar, Woolworth Building, New York City
Loder & Smith, Empire Building, Philadelphia
Brinker Supply Co., Park Building, Pittsburgh
National Good Roads Machinery Co., 174 S. Front St., Memphis
McGee & McGuire, Dallas
Miller Supply Co., Huntington, West Virginia
Francis Hankin & Co., Montreal and Toronto
Walter M. Denman, 293 Bridge St., Springfield, Mass.

# Russell

*The Stamp of Quality*

Road work should boom in 1916. Our representatives report great interest among road officials in all sizes of our machines from the two-horse "Gem" to the big "Mogul." "Elevating Grader," and "Scarifiers." Our Free Trial Offer holds good and we solicit the opportunity to "prove" that Russell machinery is the best for your purposes.

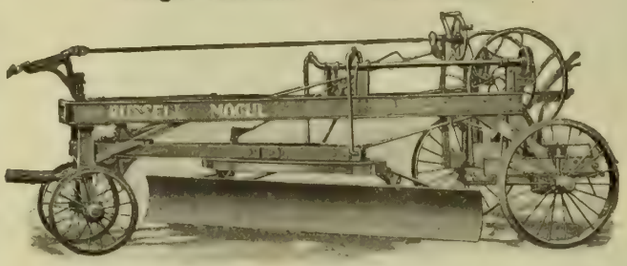
## We Make a Full Line of ROAD MACHINERY

**A MACHINE FOR EVERY SIZE WORK**

Road Machines, many sizes; Road Planers; Scarifiers; Elevating Graders; Disc Plows; Road Drags; Road Plows; Railroad Plows; Rooter Plows; Snow Plows; Wheel Scrapers; Buck Scrapers; Tongue Scrapers; Corrugated Galvanized Metal Culverts; Steel Beam Bridges; Cutting Edges, etc.

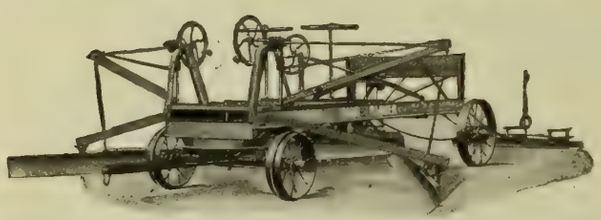
## The Russell "MOGUL"

**Weight 7000 Lbs. 12 Ft. Blade.**




The Mogul is a gigantic road builder; has no equal in strength, durability, or capacity. It is built for tractor use only and the largest tractor cannot overtax its capacity. It is simple and very easily operated. Built principally of steel with but few castings. Most parts are forged.

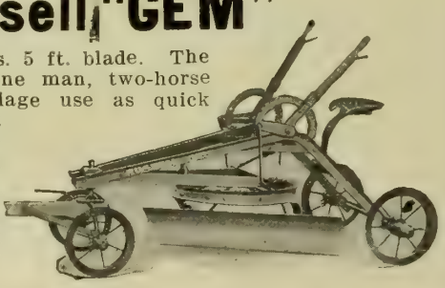
## The Russell "PLANER"



This machine offers most modern "Wholesale" method of planing and grading roads at lowest cost. Two sizes, No. 1, for tractors of 25 to 35 H. P. No. 2, for 8 horses or tractor of 15 to 25 H. P. One man operates it. Each blade adjusted independently of the other. Blades can be brought up close to machine. Dresses the entire width of road in one sweep.

## The Russell "GEM"

Weight 750 lbs. 5 ft. blade. The most desirable one man, two-horse machine for village use as quick lift levers permit crossing sidewalks without stopping team. Ideal for road maintenance. Built of steel. Most of parts forged.



**SEND FOR BIG 1916 CATALOG**

**RUSSELL GRADER MANUFACTURING CO.**

**MINNEAPOLIS, MINN.**

**Representatives in All Principal Cities**

TELL 'EM YOU SAW IT HERE.


markable figure of $.046 per ton mile, rebuilt during the past season 22½ miles of worn-out macadam on seven different roads, laying about 1,200 tons of new metal per mile; built 30 concrete bridges; laid 8,000 feet of culverts and distributed 80,000 gallons of liquid asphalt in service-treating about 25 miles of road.

As an example of the efficiency of the present system, a concrete bridge on which contractors' bids varied from $750 to $1,100, was built by Engineer Davis at a cost of only $400.

In spite of the high speed work of Fayette County, Mr. Davis takes a far-sighted and conservative view of the road building question. In an address before the Kentucky Highway Engineers, he said:

"If a community needs a good general system of roads today, the work should have been commenced twenty years ago. If a system is needed 20 years hence, it should be commenced now."

And Fayette County is practicing what it preaches. Its facilities have been developed to take care of its needs for a



**White Good Roads Truck and two Troy Trailers which reduced the cost of hauling road material to the remarkable figure of four and six-tenth cents per ton-mile.**

long time to come and modern labor-saving methods have been employed at every opportunity. The handling of road material is a gravity proposition practically from quarry to road-bed.

Stone is obtained from thirteen quarries, owned by the county but operated by contractors, supplying a central crusher manned by the inmates of the county workhouse. This stone arrives at the county supply station in freight cars which are "spotted" on a siding and unloaded by gravity directly into the new concrete material bins. Each of the eight bins have a capacity of 50 tons and each has two outlets.

When the truck and trailers appear for a load, a traveling chute, reaching from bin to truck and running on a special track, is pushed along the front of the bins until it comes into position beneath the proper outlet. By pulling a chain which lifts the door of the outlet, the driver can load his truck in a few minutes.

When the truck load is to be discharged the body is elevated by the patented power-dumping mechanism and the load is either deposited in a pile or spread to a uniform depth, which ever the foreman requires, thus completing the gravity system of hauling from quarry-car to road-bed.

Even in the handling of liquid asphalt similarly scientific methods are employed. The same spur tracks that are atop the material bins also pass above two 12,000-gallon tanks. When a carload of asphalt arrives it is "spotted" above the storage tanks, connected to the steam heating system and as soon as the asphalt is heated to a state of fluidity, it is also unloaded by gravity. These storage tanks also have interior steam coils to maintain the asphalt in liquid form and facilitate its transfer to the tank of the White Truck. The latter is




HERE is where the Koehring boom and bucket—or the Koehring platform controlled power spout makes an extra earning. When it comes to a situation as illustrated, or to paving up into cross streets, the Koehring boom and bucket or power spout gives the widest distributing range *without moving the mixer—and that means greater yardage every time.*

Right here in the drum roller bearing is one of the places vital to dependability and life of a mixer.

Koehring drum rollers, you remember, *do not* revolve on the fixed axis, but are fixed to the axis. The axis revolving in bearings on the frame. Bearings are babbitted, and can easily be re-babbitted. Easily accessible too, where they are easy to grease. And just consider the length of bearings in proportion to diameter of axis—that will show you one point of liberal, extra safety margin construction of the Koehring.

**Koehring Sizes in Cubic Feet Capacities.**

Mixers for construction work: 4, 7, 10, 12, 15, 20, 24, 33, 44. Equipped with low charging hopper, batch hopper and side loader.

Hot Mixer for bituminous pavements: 12, 20, 22. Side discharge type and end discharge type.

Paving Mixers: 6, 11, 16, 22. Equipped with distributing boom and bucket or spout.

Gasoline power, steam power or electric motor.

*Isn't it good business to get informed on mixer values now?*

Why wait until you close a contract—then it is a hustle to get ready, and hard to get right down into a money-saving, money-making investigation of mixer merits. Send for the Koehring Catalog now.

The Koehring Side Loaders are money-making equipment because of the fast discharge due to extra big pick-up buckets inside the drum.

The fast loading skip saves time on the other end. Skip goes to steep charging angle and locks in position until released. Four points of discharge control, two on each side of mixer. Beveled, grooved drum for skip cable, takes on the load gradually, and instantly increases speed. Especially with gasoline-drive mixer, this feature saves general wear and tear. Write for catalog.

## KOEHRING MACHINE CO., Milwaukee, Wis.

**Sales and Service Offices in All Principal Cities**

Boys May Come and Boys May Go But The Sign Stays There FOREVER







Made of Rust Resisting Iron "Armco" (American Ingot Iron) The Most Durable Iron Manufactured.

The letters are drilled into the plate, then filled with bright aluminum and cannot be erased.

*"The Signs That Outlive Father Time"*




For prices and other information write, or call and see us.

**THE INDESTRUCTIBLE SIGN CO.**

528 Dennison Avenue COLUMBUS, OHIO

TELL 'EM YOU SAW IT HERE.


# Specifications for Guide Signs

Designed and Prescribed by

The State Highway Department of Ohio

The guide sign shall bear the name of the town, distance in miles, and indicate the direction thereto by means of an arrow or hand. The sign shall be made of iron, and shall be finished in a workmanlike manner, making the sign easy to read, pleasing in appearance, and permanent.

## DETAILS

METAL: The body of the sign shall be a plate not thinner than 12 gauge stock when constructed of a single plate, and not thinner than 18 gauge when reinforced with heavier metal along the edges.

CHARACTERS: The letters, figures, and arrow or hand, shall be countersunk or raised about 1/16 inch. In case mounted characters are used, they shall be securely fastened to the body of the sign in such a way as to not interfere with the legibility of the sign.

TYPE: The letters and figures shall be about 2½ inches high, neatly and accurately formed and spaced. Types of letters similar to the designs attached herewith will be acceptable.

PAINT: All metal shall be free from rust or scale and shall have all its surfaces thoroughly coated with a durable paint or enamel, evenly spread. The letters shall be white and the background black, or vice versa. Aluminum may be substituted for the white. Mounted letters shall be painted on both sides. No mixing or over-running of colors will be allowed.

FASTENING: The sign shall be provided with suitable means for securely fastening it to a post.

POSTS: Posts may be of iron or any timber of lasting quality, neatly dressed and firmly set in the ground to a depth of not less than two and one-half feet. The sign shall be securely fastened to the post about six feet above the ground.

CLINTON COWEN,
State Highway Commissioner.

Columbus, Ohio, November, 1915.


***The Indestructible Sign***

COMPLIES WITH THE

***SPECIFICATIONS***

OF THE

STATE HIGHWAY COMMISSIONER OF OHIO

AND SHOULD BE USED BY ALL STATES

equipped with its own steam heating plant, utilizing the well-known White steam generator and maintaining a temperature of 260 degrees, or higher if necessary. There is also a pump driven off the transmission of the truck, which forces the asphalt through the distributor and applies it to the surface uniformly and with great penetration.

By taking full advantage of the gravity system and keeping the truck and trailers busy, the county has built roads faster and at less cost. In 120 working days from May 1 to October 31, 1915, the truck and trailers hauled 5,882 tons, as shown by the following table of railroad weights of stone hauled through the county bins:

| | |
|---|---|
| May | 1,742,300 pounds |
| June | 1,368,100 pounds |
| July | 1,801,300 pounds |
| August | 1,970,700 pounds |
| September | 2,690,440 pounds |
| October | 2,191,720 pounds |
| | 11,764,560 pounds |
| | 5,882 tons |

This tonnage was hauled at an average rate of 49 tons a day for 120 days, the distance being 4 miles one way. The cost of operation and maintenance was $9.00 per day; $.184 per ton, and $.046 per ton-mile.

A saving of $43.7 was shown by a typical day's work of the truck and trailers hauling and spreading stone for water-bound macadam construction.

Hauling material is not the only road operation whose cost has been reduced. The truck is frequently used to pull a scarifier. Occasionally it is used to draw an elevating grader as well as the common type of grader.

Quite apart from its usefulness as a road-working machine, was the ability of the truck to haul 300 tons of coal to the county infirmary between periods of other work, saving a considerable sum of money in the price that was paid for the coal.

Before purchasing the truck the only county work consisted of road patching operations in which case the rock would be dumped in piles along the side of the road and it was never in the exact place it was needed.

One of the important tasks for this year will be the construction of 23 miles of the Dixie Highway. About $400,000 is to be spent next season, first improving the main roads leading to the adjoining county seats and then the other roads leading out of Lexington. This work will consist of bituminous concrete roads built on top of the old macadam foundation. A large part of the work will be conducted under State aid but the county will reserve the right to do the work as a contractor and keep the cost as low as possible.

* * *

## New Side-Dumping Motor Truck

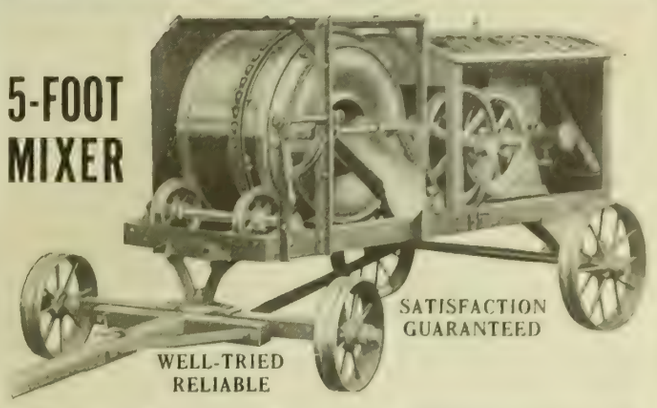
The new motor truck hauling device for road contractors shown in the accompanying illustrations consists of a Lee two-



way side dump body mounted on a Jeffery Quad chassis built by the Thomas B. Jeffery Company, Kenosha, Wisconsin. The

"NORTHWESTERN"

5-FOOT MIXER



SATISFACTION GUARANTEED

WELL-TRIED RELIABLE

This mixer is built right—therefore it works right. A 3 H. P. hopper cooled engine, standard wheelbarrow hopper, steel housing and team pole with truck of standard wagon gauge. Weight 2400 pounds. Also made in 10-foot capacity.

NOVO ENGINE furnished at small extra cost, if desired.

Send for our FREE Book No. 15 on Concrete Mixing, also details of our EASY PAYMENT PLAN.

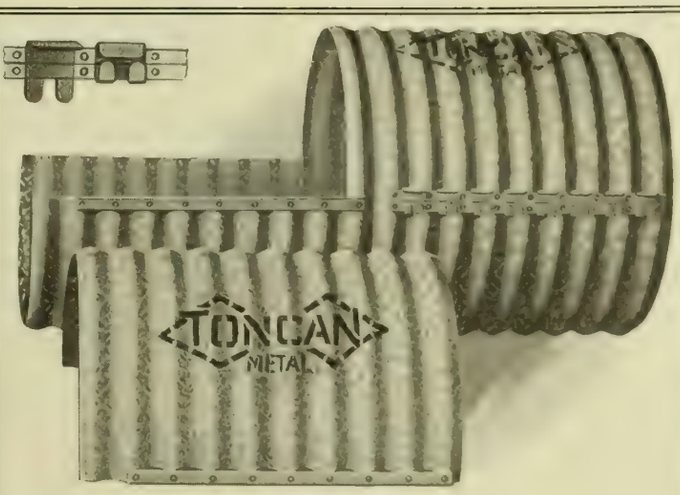
$185

Built Complete in the Northwestern Factory

Northwestern Steel and Iron Works

Eau Claire, Wisconsin

Capital Stock $200,000.00




*Here's Real Culvert Economy*

The real economical culvert is rust-resisting, non-breakable, easy to transport, install and remove, low in cost and maintenance.

Such a culvert is the

BUTT-JOINT NESTABLE CULVERT

*Made from*

Rust-Resisting TONCAN METAL Anti-Corrosive

SHEETS

Consider carefully the advantages of the Butt-Joint Nestable Toncan Metal Culvert. IT REPRESENTS TRUE ECONOMY.

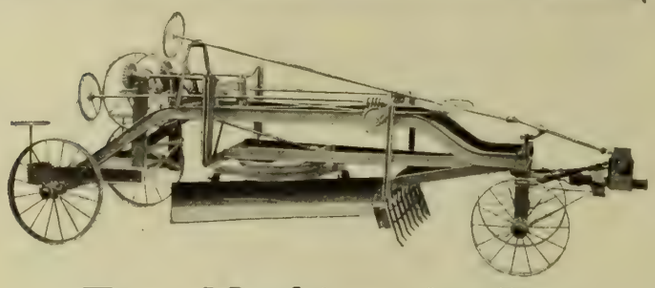
*Write for Catalog*

THE BUTT-JOINT NESTABLE CULVERT CO.

826-828 REEDY STREET CINCINNATI, OHIO

TELL 'EM YOU SAW IT HERE.

The "Panama Line"



## Two Machines in One

THE "Panama" Giant Road Machine shown above, should interest every road official.

It may be used as a grader or scarifier, or both at the same time, an uncommon feature of vital importance, as **this gives in reality two important machines in one.**

The "Panama" Giant is equipped when desired with offset engine pole; also a worm and gear steering device which responds immediately and operates with exceptional ease. Other features are: combined lateral and pivotal axle, one-piece axle, side shift blade adjustment, blade lift, roller bearing wheels, low platform, etc., all of which are explained in detail in the "Panama Line" catalogue.

**ROLLER BEARINGS**



are an exclusive and invaluable feature of the "Panama" Road Machines.



## The Most Practical Low-Priced Grader Ever Made

The "Boston" Grader meets the requirements of a drag, a two-horse grader and a four-horse grader. Special design and the "Panama" High Standard of quality make it the most practical medium weight, low priced grader ever made.

Owing to small size, light weight and roller bearings, this machine requires less power and will handle wider range of work than any similar grader. The blade can be reversed in either direction to an angle of 45 degrees, and the rear axle shifted 22 inches.

The "Boston" has worm gears, high carbon steel blade and is constructed throughout according to the most approved practice.

MAIL OR USE FOR MEMORANDUM

The F. B. Zieg Mfg. Co. Fredericktown, Ohio.

Gentlemen:-

Send your catalog as offered in Better Roads and Streets.

Name.....

Address.....

GET THE "PANAMA LINE" CATALOG



THE F. B. ZIEG MFG. COMPANY
*Fredericktown, Ohio*

TELI 'EM YOU SAW IT HERE.


operation of dumping is done entirely by hand, briefly as follows:

The body rests on three transverse rails sloping down slightfrom the center of the truck and terminating in hooks which act as final pivoting points when the body is being dumped. It is held in an upright position by two supports, one on each side, and by catches at the ends.. When these are released, the



body is rolled over on the rails, dumping the load as shown in the second illustration. Dumping is done on either side.

In a series of tests at the Jeffery factory, it was shown that the average driver could jump down from his seat, dump the load, replace and secure the body and return to his seat ready ready to drive off in half a minute.

* * *

## Report of Sub-Committee on Bituminous Concrete Paving Specifications

*(Continued from page 13)*

contractor to whom such contract shall be awarded, and are all that shall be necessary to bind Warren Brothers Company to said agreement. The filing of a bid under these specifications will be construed as an acceptance of the terms of the license agreement filed by the Warren Brothers Company, at the price fixed in said agreement, which is on file with the proper official or board.

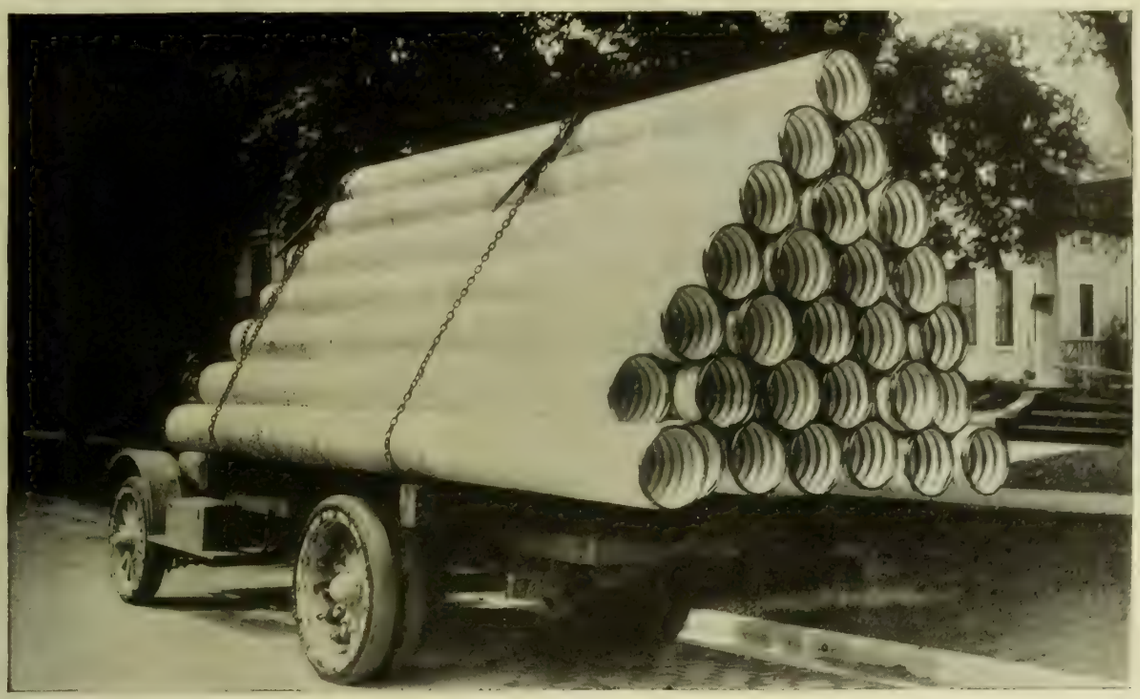
*The following report was presented by the Sub-Committee on Bituminous Concrete Paving Specifications, and will be of general interest.*

"Your Sub-Committee on Bituminous Concrete Paving Specifications, acting under instruction received at the Boston meeting of the society held in October, 1914, has prepared the foregoing specifications for bituminous concrete pavements which your committee believes provides for a pavement coming within the limits of good practice, and which does not infringe any patent that has been issued for pavements of this class. The specifications have been discussed with the president of the Warren Brothers Company and are agreed to by him as not being an infringement of any of the patents held by his company. As agreed with the Warren Brothers Company, and in accordance with instructions of this society, there is also submitted as part of the report of your sub-committee, the Warren Brothers standard specification for Bitulithic pavement.

"It is our understanding that the term 'bituminous concrete' is properly applied to any mixture suitable for paving purposes composed of broken stone, said (or other fine mineral matter) and bituminous cement, mixed together before being laid, and which is laid while in a plastic condition. To this description, to be consistent with the definition of bitumnous concrete adopted by the society, should be added, 'There must be stone enough in its composition to form an important part thereof, and add to its strength and durability.'

"The foregoing specifications have been drawn up in accordance with this definition.

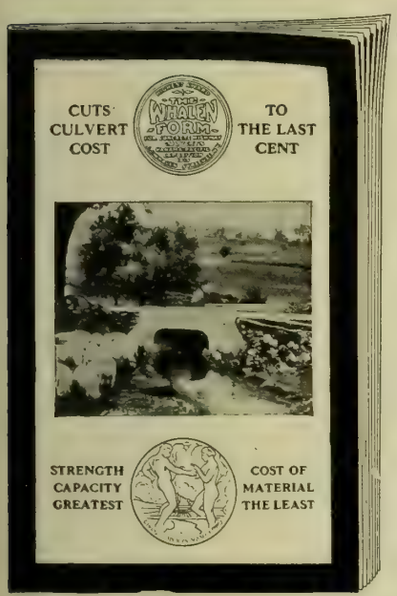
"It is our belief that bituminous concrete may be successfully used as a paving material under a great variety of conditions and traffic; that it is adapted to use on a standard concrete base and on a well-constructed mcadam base, either old



Twenty-eight Mudholes Abolished By One Truckload of "Armco" Iron Culverts.

For full information as to Rust-Resisting and Durable "Armco" (American Ingot) Iron Culverts, Flumes, Sheets, Roofing, and Formed Products, write to

**Armco Iron Culvert Manufacturers' Association, Cincinnati, Ohio**




# PROOF!

YOU Road Builders are, or should be interested in culvert construction. The most vital question in road building today is, NOT what type of material to use for the surface of the road, or what make of machinery to do the work—but **the one biggest thing in all road construction is, or ought to be, Drainage!** How to get the most water across the road at the least expense and through the most permanent structure—is a question worthy of the best of you.

A NEW BOOK HAS BEEN WRITTEN ON CULVERT CONSTRUCTION. And this book is FREE to interested readers of Better Roads and Streets. The man who compiled the information contained in it probably knows more about this subject than any man in America today. Yet it is all given to you **free for the asking.** The only request is that you mention that you saw this ad in Better Roads and Streets. The book does not confine itself to theories—but **is full of facts and figures.** Even if do not agree with all that is written—tho that is not likely—you will still find the book full of intense human interest. **It will open your eyes**—if it does no more. This is **not** a catalog—it is a free BOOK on the subject of CULVERTS. A cut of the outside front cover is shown directly to the left. Now get busy with coupon below.

**THIS BOOK FREE**

SALESMEN WANTED FOR

**THE WHALEN FORM**

401 Vinney Bldg.
SYRACUSE,
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**USE COUPON BELOW AT ONCE and Get Your Copy of This Book Free Today.**

Fill out and mail today the Coupon below addressed to The Concrete Form Co., Inc., 401 Vinney Bldg., Syracuse, N. Y.

*Send me at once postpaid, and with no charge or obligation, a copy of your new Culvert Book.*

*Name*_____ *Business or Official Title*_____

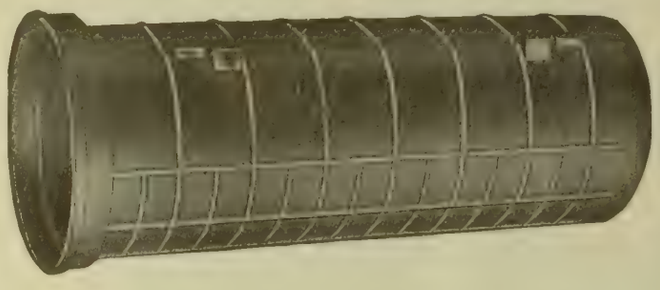
*Address* _____

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# SAVE TIME—SAVE MONEY

USE THE

## Burch Expansion Cast Iron Culvert Pipe



8 to 48 inches diameter, 3 and 4 ft. lengths. Half sections which lock with lugs.

Provides for expansion and contraction. Easy to handle and lay in ditch. Requires less excavation. Strong and durable. Send for Catalog "F" giving full description of complete line.

## THE BURCH PLOW WORKS CO.

CRESTLINE, OHIO

# Kerosene Power Cheapest for Road Work



How much more money would you make for yourself or for your community if you found a way to cut 25 per cent. off your present cost of grading roads? If you are still using horse or mule power, we can show you a way to save even more than that. If you are using a gasoline tractor, we can still show you how to make a profitable saving.

Every dollar you cut the cost of road grading is a dollar added to your net profit. We can put you in touch with one man who says he cut the cost of road grading in Louisiana from $26.00 PER MILE with mule power to $4.50 PER MILE with MOGUL kerosene tractor power. His figures are in the official records of his parish.

That is probably an extreme case, but the fact that so large a saving as this could be made, is interesting. It suggests that possibly your costs are higher than they need be. Perhaps a little investigation would pay. Would you like to see some of the figures we have collected—some of the savings we have helped other contractors and road builders to make by changing over to MOGUL or TITAN kerosene tractor power? They'll cost nothing but a two cent stamp and a little time. Write for them.

## International Harvester Company of America

(Incorporated)

152 Harvester Building CHICAGO, U. S. A.

TELL 'EM YOU SAW IT HERE.


or new, and therefore finds an especial field in providing a permanent wearing surface for old macadam.

"In the preparation of these specifications, we have endeavored to recommend only methods, proportions and materials that have been tried and have proved successful under a variety of conditions. For this reason, only the bituminous cements have been considered that retain approximately their original consistency after going through the process of mixing and laying, and are permanent in quality thereafter, excluding from consideration in this connection, emulsions, oils, volatile in character, and cements softened with light fluxes so that they may be worked cold or at low temperature. Thus the cements specified are practically solid at ordinary atmospheric temperatures, and require to be heated and mixed with the stone and sand while they are hot. The processes specified require the use of standard machinery in which the bituminous cement is not exposed directly to the action of fire during the process of mixing.

"In these particulars, we have endeavored to be conservative, believing there is danger in offering anything but tried and proved materials and methods in a standard specification.

"We do not consider that the foregoing specifications should be used in their entirety exactly as written in any case, as the effort has been made to produce specifications general in character which may be adapted to varying conditions of traffic. Thus the extreme range of penetration for asphaltic cement has been made from 40 to 85, which is too wide a range to admit for any particular case. A penetration of 40 will give a hard, stable pavement, while 85 will give a pavement too soft for heavily traveled streets. The choice should be made to meet conditions and the specifications applying to any particular case drawn closer within the limits named for penetration, working temperatures, etc. The engineer in charge should secure complete reliable analyses of the bituminous cements he contemplates using from chemists making a specialty of bituminous products and compare them on all important points, not considering the same necessarily satisfactory because the results come within the extreme limits specified.

"Asphaltic cements made from both natural and manufactured asphalts come within the requirements of the foregoing specifications."

* * *

## Some New Departures in Asphaltic Concrete Construction Tried Out in Oak Park, Ill.

*(Continued from page 6)*

the foundation. If the old pavement had been taken up, it would have been necessary to lay the new pavement at least three and one-half inches thick. In carrying out this work, the old asphalt was cut out only for a distance of approximately four feet from the gutter line. In addition, all badly disintegrated asphalt was removed and the holes filled with a binder course, thoroughly compressed.

After repair of these holes, a course of binder was laid over the entire street, from gutter to gutter, to give proper crown and shape, and to afford proper grade at the gutter line and over the old surface for the new wearing course. Upon this binder was placed the grit mixture previously described, finished with Portland cement thoroughly brushed into the interstices in the usual manner. This pavement appeared at first to be superficially open, and insufficiently closed, but after a couple of weeks of traffic, it closed up nicely, and presented an excellent surface, so that at present the surface finish cannot be distinguished as out of the ordinary.

Observations of this type of mixture upon the work in general indicated the desirability of somewhat unusual handling in order to secure a smooth surface. It was found that the mixture would not be displaced or squeezed out under a light roller sufficiently to shape smoothly, and, after considerable trial, it was apparent that the most desirable method of rolling consisted in running a heavy roller, weighing at least ten tons, close upon the mixture for initial compression. This roller was then allowed to lay back for a considerable time, as a second rolling, immediately following the first, tended to crack the surface open.

After the elapse of sufficient time to permit the surface to partially cool, further rolling would be resumed and a much

better surface secured in this way than by use of light rollers for initial compression.

The reason for this difference in behavior as against that of sheet asphalt in rolling, apparently resides in the inability of the grit mixture to squeeze out under the light roller owing to the nature of the aggregate. The sand particles of the sheet mixture undoubtedly are much more easily displaced in relation to each other than the angular fragments of a mixture in which grit predominates. In other words, in the grit mixture the particles are locked together preventing easy displacement.

Another feature of interest in connection with this form of construction is the possibility of using, as squeegee or surface finish, a grout of Portland cement instead of the dry cement. A small portion of one of these streets was finished in this way. A very thin grout was prepared of Portland cement of a creamy consistency, and was distributed over the surface of the pavement by means of brooms in such a manner as to fill the superficial interstices. The handling of the grout required care and it was necessary to keep it constantly agitated to maintain uniform consistency.

Examination of the portion treated in this manner, after a year of traffic, showed some difference from adjoining sections which were treated with the dry cement, but the difference was not particularly marked. The effect of the use of the wet cement, instead of the dry, appeared to result in better protection of the stone particles which carried the weight of traffic. In other words, traffic, in closing up the surface which had been treated with dry cement, appeared to have abraded and worn away the points of exposed stones to a greater extent than where the cement had been applied as a wet mix and had set hard into the interstices. It is possible that further observation and trial along these lines may develop results which would well justify the constant use of this form of surface finish.

While no feature of the above work is radically new, the various points mentioned are thought to be of some interest, and the more general application of this particular construction for streets of motor or of light traffic is deemed worthy of wider consideration.

* * *

## Snow Fighting in Our Largest City

(*Continued from page* 10.)

ful. It is always an easy matter to bury tools under the snow when dumping the snow at the manholes, and many shovels were lost in this way by being pushed into the manhole.

Vacancies in the squads may be filled at the time they occur.

At the beginning of the storm, when all Department of Street Cleaning employees assist in the starting of the work, those assigned to the second shift will be paid for time they worked with the first shift. For the sweepers, there will be issued squad leaders' cards without having any laborers' numbers entered thereon. These tickets will be punched the same as has already been described, and their time is then to be entered upon the payroll of the first shift.

In case of the absence, at the commencement of the work, of any Department of Street Cleaning employees assigned to Shift No. 1, their places will be taken by the corresponding employees for Shift No. 2, and who will then work with Shift No. 1 during the storm. Their places in Shift No. 2 will be filled by the employees of Shift No. 1 if they appear, and if they do not appear, the places will be filled by a detail made by the section foreman.

In addition to the general orders that have been issued by Commissioner Fetherston, supplementary orders and instructions for each storm and covering methods of working on each route, as well as for special localities, are issued. This applies particularly to the localities in New York where it is known that the snow cannot be disposed of by the use of the sewers.

In this article, only the procedure of the Snow Fighting Force has been taken up. This is merely supplementary to the regular method of snow removal in New York City, which is by contract. In the March issue of BETTER ROADS AND STREETS, the author will present another article, which will be illustrated, showing how the snow is handled by contract, and showing some photographs taken during the January snow storms in New York.




CAREY Elastite JOINT

**With a Hundred Per Cent. Satisfaction!**

Some time ago we asked several hundred contractors, who had used large quantities of Elastite, to write us their frank opinions as to its value as compared with the poured expansion joint.

Three hundred of these men answered our letter. Two hundred and ninety-nine of them were enthusiastic in their praise of the new product.

The other one man replied by sending us his order for fifteen hundred feet *to be rushed.*

If you are interested, write for samples, letters from users and specifications.

**THE PHILIP CAREY COMPANY**

**14 Wayne Avenue, Lockland** **Cincinnati, Ohio**

# Down at Ironton, Ohio they're "moving the earth"

and as this picture and the testimony of our customers, the Ironton Transfer Company, clearly shows, there wasn't much of it that needed "doing over"!

This picture was taken just as they were rolling down a heavy course of crushed stone, and the "lay" of the material behind the Roller shows that the job was being done RIGHT. No doubt but it would "stay put" after a "New Huber" had been along!

The Ironton Transfer Company, and other experienced users, will gladly tell you that

**Using "New Huber" Road Rollers Keeps Road-Making Costs Away Down**

both in the item of "first expense" and also in the matter of upkeep, by doing an extra-thorough piece of work as it goes.

*We have the FACTS TO PROVE that "New Huber" Road Rollers are the one economical "buy" for those who want to do the work RIGHT and at low expense in the first place—and with a minimum of upkeep cost later on.*

*The record of "New Hubers" in work is the best proof you could ask, and we shall be glad to submit the evidence if you will write us — or better still, if you will come to the factory and see for yourself.*



THE HUBER MFG. CO.

Road Rollers and Scarifiers
Gas Tractors Steam Engines
Threshing Machines Etc.

Station 6

MARION, - OHIO

TELL 'EM YOU SAW IT HERE.

# Build Macadam Roads

The macadam road is gaining favor each day.

It is the oldest and best class of road construction in Europe and America.

Thousands of dollars are being spent annually to promote Brick and Concrete Roads, BUT BEAR IN MIND THAT A BRICK ROAD COSTS MORE THAN TWICE AS MUCH AS MACADAM and Concrete increases the cost nearly one-half and neither will wear any longer than a high standard Macadam Road.

Figure the total cost of each road covering a period of twenty years or longer and you will adopt macadam.

Get the facts before adopting your specifications.

Write us for information on stone and slag macadam, water-bound, or treated with asphalt or tar.

We can make delivery of crushed stone or slag in all parts of Northern Ohio, Eastern Ohio, Northern Indiana, and Southern Michigan.

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TOLEDO, OHIO

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## Keep The Crews Busy This Winter

THE problem of how to continue road construction during cold weather finds a solution in many cases

**BY USING THE**

**Low-Freezing Explosives**

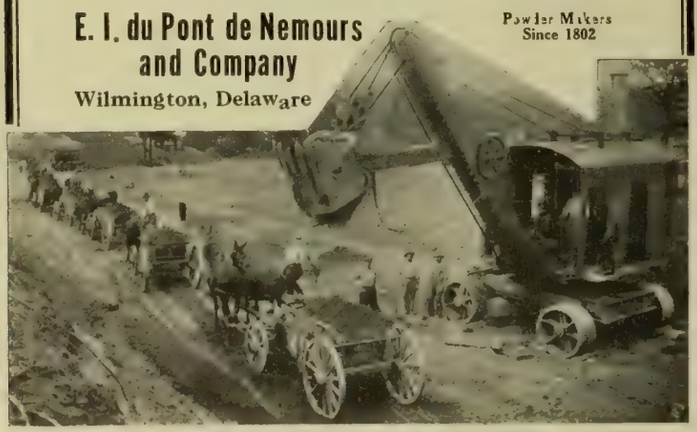
made by the Du Pont Company. A few explosions of Red Cross Powders will loosen the frozen top soil, shatter stumps or boulders, open a ditch, smash a culvert, dig post holes or other work along the highway. No thawing is necessary except in near zero weather, if Red Cross Low Freezing Powders are used to keep your crews busy this winter.

FOR INSTRUCTIVE BOOKLET ABOUT USING EXPLOSIVES IN ROAD-BUILDING, WRITE FOR "ROAD CONSTRUCTION AND MAINTENANCE."

**E. I. du Pont de Nemours and Company**

**Wilmington, Delaware**

Powder Makers Since 1802



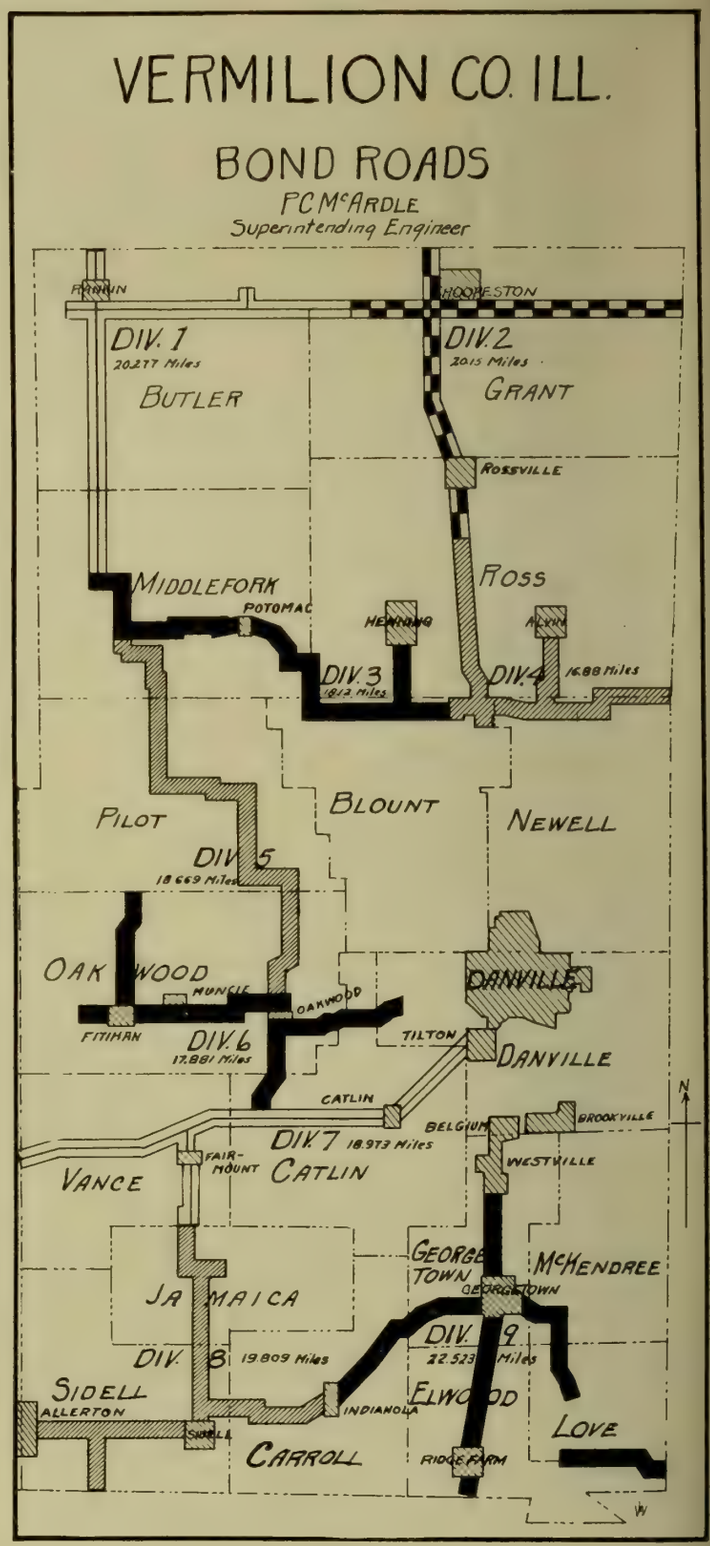
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## Vermilion County, Illinois, Blazes the Trail

*(Continued from page 5)*

It is proposed to ask for bids on both types, concrete and brick, about February 15, and to let the work at the March meeting of the Board of Supervisors on March 14, 1916. Active construction will probably start some time in May.

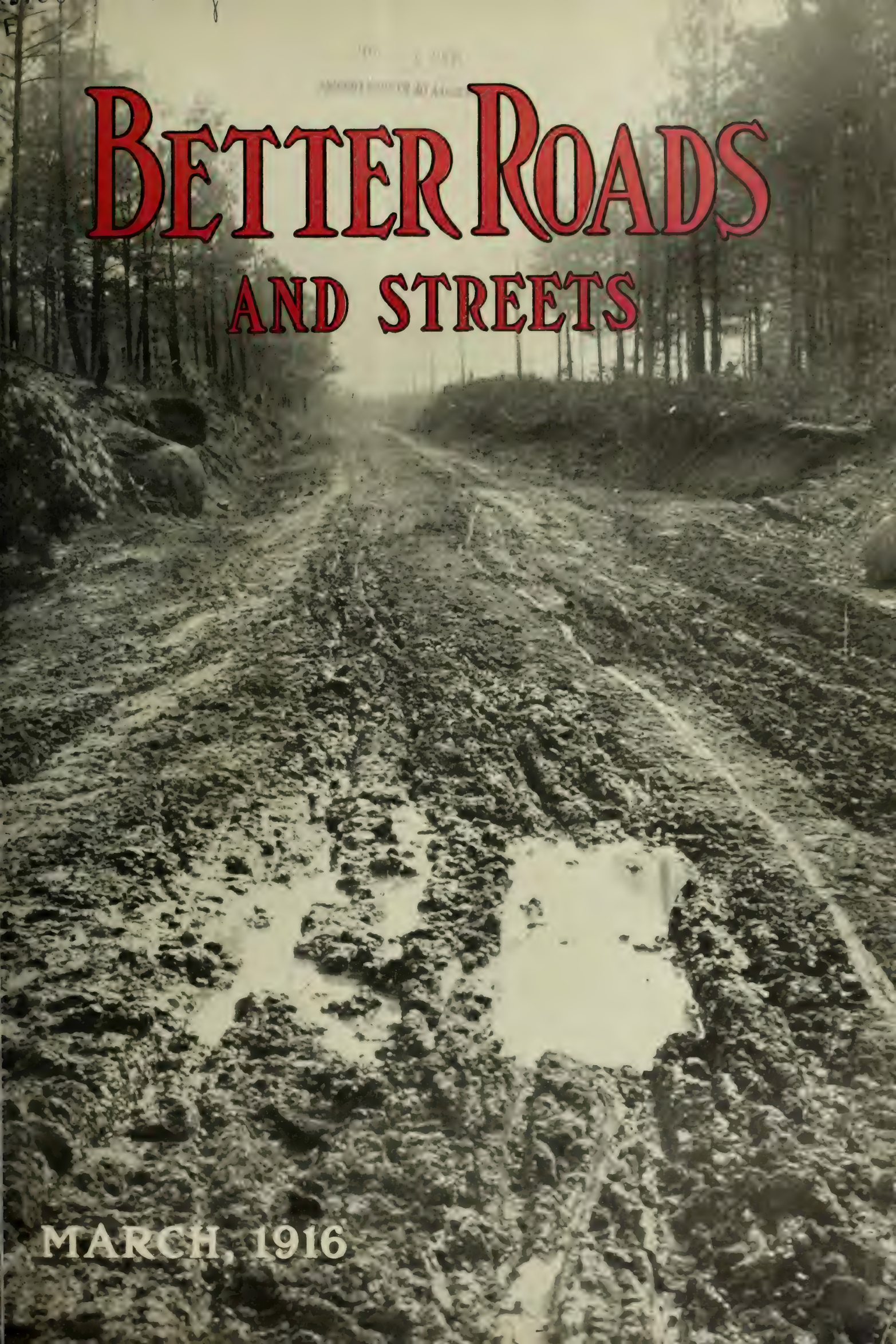
Vermilion County is fortunate in securing the services of P. C. McArdle, Assistant Chief State Highway Engineer of Illinois as superintending engineer in direct charge of all




the work. Mr. McArdle last summer obtained a leave of absence from the State Highway Department in order to take over this work.

William S. Dillon, County Superintendent of Highways of Vermilion County, will be associated with Mr. McArdle. Mr. Dillon has been in charge of the surveying and preliminary work.

# BETTER ROADS AND STREETS



MARCH, 1916

# "It Does Work Horses Couldn't Do"

ON MAY 7, 1914, I purchased a three-ton Garford truck. Since that date it has been in constant use in my business hauling sand, gravel, lumber and cement on the rough streets of Cincinnati and outskirts.

I used it to haul sand and stone to the new buildings of the Cincinnati Tuberculosis Hospital in Lick Run, a suburb, and to the new City Ice Delivery Company's plant at Price Hill. In order to reach the latter place it was necessary to climb Price Hill, a task which few cars will attempt.

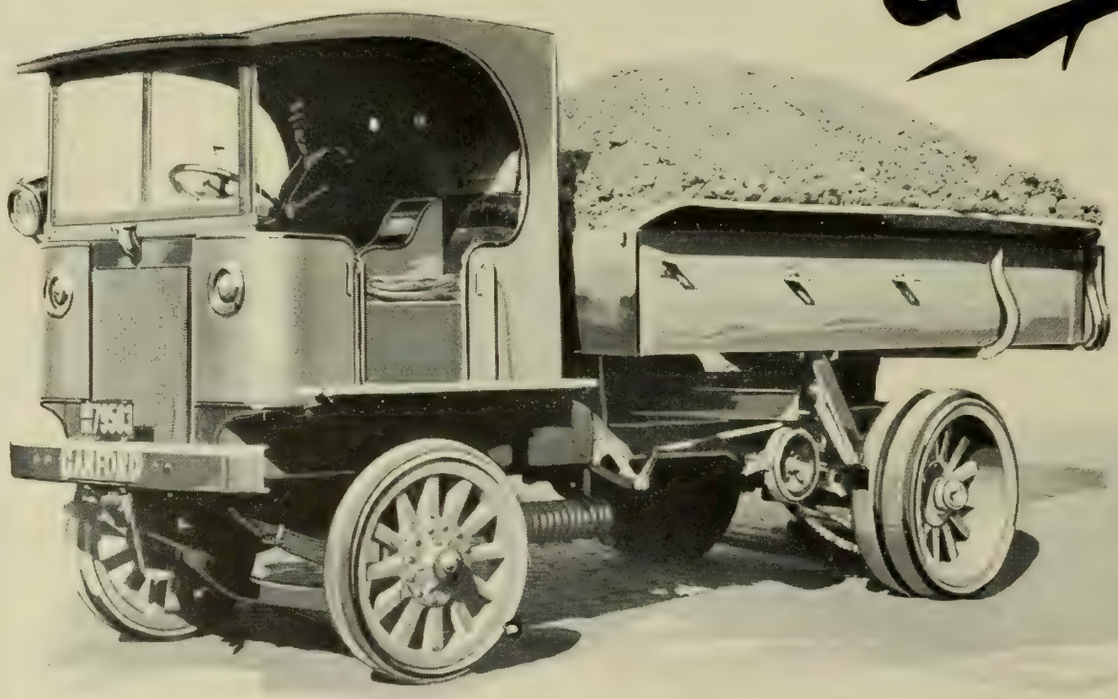
The Garford has been run under all kinds of weather and traffic conditions, taking, in midwinter, capacity loads of coal up the steepest hills of Cincinnati—work that horses couldn't possibly do.

From the beginning the repair bills have been very small.

D. MEINKEN
CONTRACTOR AND BUILDER
CINCINNATI, OHIO

Garford

¾, 1, 1½, 2, 3, 5 and 6 ton capacity



**A Truck For Every Purpose**

## Garford Motor Truck Co., Lima, Ohio

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# Better Roads and Streets

VOL. VI. NO. 3 MARCH, 1916 PRICE FIFTEEN CENTS

# Report of the Special Committee on Materials for Road Construction and on Standards for their Test and Use

A very complete and well-prepared progress report of this most important committee was presented at the annual meeting of the American Society of Civil Engineers at the Society House, New York City, on January 21, and together with the discussion thereon, consumed the entire day. Many written discussions were presented, as will be noted in the account of the meeting on another page. Arrangements were also made at the meeting to have additional data, information, and suggestions submitted to the committee by interested authorities following the meeting.

BETTER ROADS AND STREETS, it will be remembered, created a very favorable impression last year in giving thousands of its readers who are not members of the American Society of Civil Engineers early information by the publication of the report on bituminous materials, and this year presents in complete form the unabridged report of the Committee.

This report is as follows:

Your Special Committee on "Materials for Road Construction, and on Standards for Their Test and Use," has, during the past year, endeavored mainly to consider the new field assigned to it by the Board of Direction at the Annual Convention in June, 1914, and to prepare for presentation, at this time, such a report on materials, other than bituminous, used in road construction as would thereby place both the bituminous and the non-bituminous highway materials on the same footing, in so far as the work of this Committee and its duties to the Society are concerned.

The demands on the time of this Committee have been so great as to prevent a satisfactory revision of the Semi-Final Report on Bituminous Materials submitted in 1915, and to compel it to defer such revision for another year. It is the intention of your Committee during 1916 to review its reports of 1915 and 1916, and to present a revised report on both these branches of its subject to the Annual Meeting in January, 1917.

### SEMI-FINAL REPORT ON NON-BITUMINOUS MATERIALS.

Your Committee first wishes to call attention to the propriety of the application to non-bituminous materials of many of the conclusions submitted in its Semi-Final Report on Bituminous Materials used in highway work, and, in order to avoid unnecessary repetition thereof in this report, it recommends reference to its report of a year ago, and the application of all its conclusions, therein expressed, as may be proper in this connection, to non-bituminous highway materials, in addition to the specific statements hereinafter made.

A considerable variety of non-bituminous materials and of methods of using them exists in highway construction and maintenance. Some of these materials have been in use for many years, and some of the practice in the test or use of them has become fairly well standardized. On the other hand, many of the materials are new, and more or less change has occurred in their tests or use, and is even now taking place. Local conditions have had much to do with the selection of the material and the determination of the particular method to be followed in any specific case.

Your Committee has considered it impracticable to attempt to cover all the various non-bituminous road materials in this report, but has considered especially what seem to be the more important ones. It is believed that many of the questions affecting the selection or use of these materials can only be solved by a better knowledge of their characteristics or qualities and more complete records along uniform lines of their behavior in use. It, therefore, recommends that the needed information concerning the materials be secured along the lines laid down under the various headings, in order that conclusions of value may be reached and a general agreement in the records thus obtained.

In its work on bituminous materials, your Committee has attempted to initiate and encourage the collection of comparable records concerning non-bituminous highway materials by arranging, for the purpose, forms which will be widely distributed to highway authorities.

(NOTE.—Copies of all of these forms will be found in proper places following the last of this report as published in BETTER ROADS AND STREETS.)

The Committee, recognizing the importance of the factor of costs, both first and subsequent, in almost all pavement questions, has, for the same reasons, attempted to initiate and encourage the collection of comparable records of cost figures by the preparation of forms for this purpose. Copies of these forms will be found in Appendix A. Both these forms apply to the particular material or methods used on specific areas of road or street surfaces. For comparisons of cost figures in connection with the study of relative costs between streets or considerable sections of a traffic route, your Committee reiterates the recommendations contained in its report of January 20, 1915, under the heading "Collection and Standardization of Cost Data." It should also be noted that the traffic data provided for in the part of Appendix A relating to cost data are not intended to supplant those given under traffic census.

In submitting its conclusions, your Committee has, for convenience, arranged them under separate classifications. It should be distinctly understood that the Committee has deliberately refrained from including in this report such conclusions regarding any material or method as appear to have been generally agreed on. On the other hand, no conclusions have been stated unless supported by a substantial majority of the Committee's membership.

Your Committee offers such conclusions (other than its forms referred to) as it has been able to reach during the past year on non-bituminous highway materials as follows:

### GENERAL.

Your Committee considers it still of sufficient importance to warrant the repetition here of its previous statements to the effect that there is no such thing as "the most satisfactory roadway surface" or as a "panacea" for all highway ills, and that the proper selection of the particular material and methods of construction to be used, which will most efficiently meet the conditions of any particular case, is the real problem to be solved.

Your Committee recommends that the selection of the kind of crust or pavement be based on the following factors, the special value of which may be estimated in each case under the local conditions of traffic, surroundings, climatic conditions, and physical and financial resources, both as to construction and maintenance, with proper regard for probable or possible changes in these circumstances: first cost, maintenance cost, annual cost (interest on first cost plus maintenance cost plus annuity), ease of maintenance (facility for making repairs), durability, cleanliness, tractive resistance, slipperiness, favorableness to travel, sanitariness (especially when not properly cleaned), noiselessness and appearance.

### BROKEN STONE AND SLAG ROADWAYS.

The size of stone in the wearing course should be as large as practicable, but not so large as to lead to its being dislodged under traffic.

Within limits, the softer or more cementitious the stone used for the wearing course, the larger its size should be.

The size of stone in the bottom course should be within the maximum limit which will insure its stability under traffic and other stresses, and may be of any size that will result in the economical use of the crusher product.

The utmost possible compaction of the courses, before the addition of the void-filling material, is desirable.

Thorough filling of the otherwise irreducible voids is desirable, and a slight excess of the void filler on the surface of the wearing course will usually be found to be of value.

For a water-bound broken-stone roadway, the void filler should be clean stone screenings or sand, and the use of clay should be avoided. A proportion of fine mineral material, between certain maximum and minimum sizes, which proportion and sizes will depend largely on the character of the materials, is desirable.

For water-bound roadways of some limestone or of some slags, it will be advisable wherever practicable to use for one-half the void filler a non-cementitious material such as clean sand with the other half of the finer particles of the material itself.

Dense, tough slag is preferable to the more porous or to the vitreous varieties, and it should be free from metallic pieces.

Such proportions of the various sizes of material used as will result in the greatest possible density of the roadway, when properly compacted and bound, are desirable.

### GRAVEL ROADWAYS.

The conclusions expressed under the head of "Broken Stone and Slag Roadways" apply in a general way to gravel roadways, except as follows:

With rounded gravel the tendency toward dislodgement under traffic is greater than with angular broken stone, and hence, for equal resistence to this tendency, the size of the pieces in the courses of the roadway must be somewhat smaller with gravel than in the case of broken stone.

With gravels such as quartz, the cementation of which is extremely low, a highly cementitious void filler is desirable, and a moderate quantity of clay in sand used for filling the interstices of water-bound gravel surfacing may be advantageous where the water and frost action on the roadway surfacing is not too severe.

Where the roadway is constructed of run-of-bank gravel it will contain enough stone of the larger size to insure stability and wearing qualities under traffic, and sufficient finer material to insure a proper bond.

The Committee is of the opinion that uncarpeted roadways should be used only for light traffic.

### CEMENT-CONCRETE PAVEMENTS.

The sub-grade for a cement-concrete pavement should always be as carefully prepared, rolled and compacted as for any other roadway, and should be made to conform to the proper lines and grades.

The value of a sand layer under cement-concrete pavements, to allow for expansion and contraction, appears as yet to be undetermined, and further experimental data bearing on this point are desired.

Expansion joints, when provided in a roadway slab or pavement, should be designed and installed so as to interrupt to the minimum degree practicable the uniformity of the surface; should be placed at intervals of approximately thirty feet, and may be built with advantage at an angle of from seventy to eighty degrees with the axis of the road.

Too much emphasis cannot be laid on the importance of frequent testing of the materials. This testing should include, not only the cement, but also the fine and coarse aggregates. The most desirable fine aggregate is that which is properly graded from the maximum-sized particles downward, so as to have the greatest density.

The importance of thoroughly mixing the concrete is of such great moment that it can hardly be over-emphasized. The denser the concrete, other things being equal, the greater will be its strength and value. Every effort should be made to obtain by proper proportion and workmanship, the greatest density practicable, under the existing conditions of any case, and the proportions of the various ingredients should be rationally determined and not be arbitrarily dictated or assumed.

Uniformity of character and composition being a most desirable quality of the completed pavement, every effort must be made to meet and offset the various tendencies toward non-uniformity particularly prevalent in concrete work, such as variations in proportions of sizes and materials, segregation of the mix during its preparation, and variation in compaction, setting and drying of the mass.

In all cases the surface of the finished pavement should be kept wet, and, if possible, protected from the sun for several days.

### BRICK AND SLAG BLOCK PAVEMENTS.

Toughness, resistance to wear from shock or abrasion, and non-absorption are essential qualities. The first two can be determined by the standard rattler test, and the last by the customary absorption test through immersion in water. Uniformity in the rate of wear is equally important, and may properly be a controlling consideration, even at the expense of a moderate sacrifice in the rate of wear.

Although the use of sand joints may occasionally appear to be justified, in the interest of economy, it is unwise to use them when some additional first cost will result in appreciably prolonging the life of the pavement. Cement joints, when properly made, will maintain the integrity of the surface, but uniformity in the cement grout and special skill and care in its application are essential to success.

Such form of the individual brick or block is desirable as will automatically provide sufficient, but not too wide joints, and as will insure uniformity in their width, even when they are laid rapidly and with ordinary care.

The thickness of the sand cushion used is often excessive. The function of this cushion is to give some resiliency to the wearing course, and to allow for irregularities in the surface of the concrete foundation and for unavoidable variations in the depth of the brick or block. As the variation in depth (of the brick or block) decreases, the thickness of the sand cushion can be correspondingly decreased. If the variation in the depth does not exceed one-eighth-inch, and if the surface of the concrete foundation is sufficiently even, a cushion course one inch, or even three-fourths-inch in depth will be enough.

The Committee recommends further investigation of the possible use of a bituminous cushion and a cement mortar bed in place of the sand cushion for brick and slag block pavements.

### STONE BLOCK PAVEMENTS.

The recent and present tendencies toward smaller and better dressed blocks should be encouraged, to the end that closer joints between the blocks may be had and that greater uniformity in the thickness of the cushion under the blocks may be secured. Under average conditions, for a given class of pavement, stone blocks used in various parts of America should, in the interests of low first cost and economical manufacture, comply with the same requirements relative to dimensions and dressing of the several faces.

The thickness of the sand cushion often used is excessive. The function of this cushion is to give some resiliency to the wearing course, and to allow for irregularities in the surface of the concrete foundation and for unavoidable variations in the depth of the block. As the variation in depth (of the block) decreases, the thickness of the sand cushion can be correspondingly decreased. If the variation in the depth does not exceed one-half inch, and if the surface of the concrete foundation is sufficiently even, a cushion course one inch in depth will be enough. The Committee recommends further investigation of the possible use of a bituminous cushion in place of the sand cushion for stone block pavements.

Stone block pavements should generally be laid on a cement-concrete foundation, but in case of temporary paving, any type of well-drained stable foundation may be used.

Stone blocks should be composed of medium or fine-grained granite or sandstone having a percentage of wear of not more than 4.5, and a toughness of not less than 8. Sandstone and granite for stone blocks should have crushing strengths of not less than 16,000 and 20,000 pounds per square inch respectively.

As it is desirable to secure a suitable water-proof wearing course for pavements, sand should never be used alone as a joint filler. A bituminous filler may be preferred to a cement grout filler on account of the lower cost of street-opening re-

pairs, the better foothold provided for horses and the securing of a more resilient and, hence, less noisy pavement.

The utilization of recut stone blocks has been demonstrated to be capable of producing economical and satisfactory results, and should be encouraged.

WOOD BLOCK PAVEMENTS.

There is no general necessity for confining the material for wood paving blocks to long-leaf Georgia pine (Pinus palustrus).

Such form and shape of the individual block, or such method of laying as will insure the placing of the blocks with the fiber normal to the surface of the pavement and provide uniform joints, even when the blocks are rapidly and not overcarefully placed, are desirable.

Experience has demonstrated that an excessive quantity of preservative involves additional cost without compensating advantages, and, if too little is used, it may fail of its purpose. Under normal conditions, it would appear that not less than fifteen nor more than twenty pounds per cubic foot should be used.

No necessity exists, in the case of a wood block pavement, for a resilient cushion under the blocks, and the reduction of any provision for a cushion or bed, in or on which the blocks may be laid, to such a layer as may be necessary safely for the purpose of correcting the uneveness of the foundation and of permitting the immediate compensation for irregularities in the depths of the blocks themselves, is desirable. It is also desirable that such an intermediate layer between the foundation and the blocks shall be of such character as will insure its permanence in the position it occupies when the pavement is opened to traffic.

In filling joints, three different materials have been used, and all have their advocates. Although it is possible that all are good under different circumstances, neither experience nor experiments has made it certain which one is the best.

Your Committee wishes to take this opportunity to express its appreciation of the interest shown in its previous report, and of assistance given the Committee by those who contributed discussion on it. It regrets that, as stated, pressure of other matters has prevented proper consideration of the criticisms or discussion offered, up to this time, but, during the coming year it hopes to be able to digest properly the suggestions made, and thereupon to embody revised and further conclusions in its next report.

The Special Committee on Materials for Road Construction and on Standards for their Test and Use is composed of the following gentlemen: W. W. Crosby, Chairman; H. K. Bishop, Arthur W. Dean, Nelson P. Lewis, C. J. Tilden, George W. Tillson, and Arthur H. Blanchard, the last named being the secretary.

## APPENDIX B.

## ANALYSIS AND TESTS OF NON-BITUMINOUS ROAD MATERIALS AS RECOMMENDED BY THE SPECIAL COMMITTEE ON MATERIALS FOR ROAD CONSTRUCTION AND ON STANDARDS FOR THEIR TEST AND USE, OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

The adoption of the following lists of tests, as including all those which will probably be of value in determining and recording the characteristics of non-bituminous highway materials was recommended by the Special Committee on Materials for Road Construction and on Standards for their Test and use of the American Society of Civil Engineers at the annual meeting in January in New York City.

BROKEN STONE AND BROKEN SLAG.

Name and Origin
Specific Gravity
Absorption of Water per Cubic Foot
Abrasion Test, Percentage of Loss
Toughness Test
Cementation Test
Crushing Strength per Square Inch
Mechanical Analysis
Voids, Percentage of, Loose and Compacted

GRAVEL

Location
Specific Gravity
Abrasion Test, Percentage of Loss
Cementation Test
Mechanical Analysis
Voids, Percentage of, Loose and Compacted

SAND

Location
Specific Gravity
Mechanical Analysis
Voids, Percentage of, Loose and Compacted
Tensile Strength in Cement Briquettes, as Compared with Standard Ottawa Sand

MIXTURES OF SAND OR OTHER FINE HIGHWAY MATERIAL WITH BROKEN STONE, BROKEN SLAG OR GRAVEL

Specific Gravity
Mechanical Analysis
Voids, Percentage of, Loose and Compacted

PAVING BRICK

Composition
Name of Manufacturer
Rattler Test

STONE BLOCK.

Name and Origin
Specific Gravity
Absorption of Water per Cubic Foot
Abrasion Test, Percentage of Loss
Toughness Test
Hardness Test
Crushing Strength per Square Inch

WOOD BLOCK.

Character of Wood
Weight of Blocks per Cubic Foot
Soundness
Rings per Radial Inch
Quantity of Preservative per Cubic Foot
Absorption of Water after Treatment
Character of Preservative:
Specific Gravity at 25 Degrees Centigrade
Specific Gravity at 38 Degrees Centigrade
Solubility in Benzol or Chloroform
Water Content
Distillation:
Up to 170 degrees Cent. (338 degrees Fahrenheit)
170 degrees C. (338 degrees F.) to 200 degrees C. (392 degrees F.)
200 degrees C. (392 degrees F.) to 210 degrees C. (410 degrees F.)
210 degrees C. (410 degrees F.) to 235 degrees C. (455 degrees F.)
235 degrees C. (455 degrees F.) to 270 degrees C. (518 degrees F.)
270 degrees C. (518 degrees F.) to 300 degrees C. (572 degrees F.)
300 degrees C. (572 degrees F.) to 315 degrees C. (599 degrees F.)
315 degrees C. (599 degrees F.) to 355 degrees C. (671 degrees F.)

CEMENT.

All properties to be determined in accordance with methods recommended by the Society's Special Committee on Concrete and Reinforced Concrete.

It is further recommended that the following methods for performing these tests be adopted as standards:

APPARENT SPECIFIC GRAVITY OF ROCK.

The apparent specific gravity of rock shall be determined by the following method: First, a sample weighing between twenty-nine and thirty-one grams and approximately cubical in shape shall be dried in a closed oven for one hour at a temperature of 110 degrees Centigrade (230 degrees Fahrenheit), and then cooled in a desiccator for one hour; second, the sample shall be rapidly weighed in air; third, trial weighings in air and water of another sample of approximately the same size shall be made in order to determine the approximate loss in weight on immersion; fourth, after the balance shall have been set at the calculated weight, the first sample shall be weighed as quickly as practicable in distilled water having a temperature of twenty-five degrees Centigrade (seventy-seven degrees Fahrenheit); fifth, the apparent specific gravity of the sample shall be calculated by the following formula:

$$\text{Apparent Specific Gravity} = \frac{W}{W - W'}$$

in which $W$ = the weight in grams of the sample in air and $W'$ = the weight in grams of the sample in water just after immersion.

Finally the apparent specific gravity of the rock shall be the average of three determinations, made on three different samples according to the method above described.

APPARENT SPECIFIC GRAVITY OF SAND, STONE SCREENINGS, OR OTHER FINE HIGHWAY MATERIAL.

*Apparatus*—The determination shall be made with a Jackson specific gravity apparatus which shall consist of a burette, with graduations reading to 0.01 in specific gravity, about twenty-three centimeters (nine inches) long and with an inside diameter of about 0.06 centimeters (0.25 inch), which shall be connected with a glass bulb approximately thirteen centimeters (5.5 inches) long and 4.5 centimeters (1.75 inches) in diameter, the glass bulb being of such size that from a mark on the neck at the top to a mark on the burette just below the bulb, the capacity is exactly 180 cubic centimeters (6.09 ounces); and an Erlenmeyer flask which shall contain a hollow ground-glass stopper having the neck of the same bore as the burette and a

capacity of exactly 200 cubic centimeters (6.76 ounces) up to the graduation on the neck of the stopper.

*Method of Determination*—The method shall consist of: First, dry at not more than 110 degrees Centigrade (230 degrees Fahrenheit) to a constant weight a sample weighing about fifty-five grams; second, weigh to 0.1 gram, fifty grams of the dry sample and pour it into the unstoppered Erlenmeyer flask; third, fill the bulb and burette with kerosene, leaving just space enough to take the temperature by introducing a thermometer through the neck; fourth, remove the thermometer and add sufficient kerosene to fill exactly to the mark on the neck, drawing off any excess with the burette; fifth, run into the flask about one-half of the kerosene in the bulb to remove air bubbles and then run in more kerosene, removing any material adhering to the neck of the flask, until the kerosene is just below the ground glass; sixth, place the hollow ground-glass stopper in position and turn it to fit tightly, and then run in kerosene exactly to the 200 cubic centimeter (6.76 ounce) graduation on the neck, care being taken to remove all air bubbles in the flask; seventh, read the specific gravity from the graduation on the burette, and the temperature of the oil in the flask, noting the difference between the temperature of the oil in the bulb before the determination and that of the oil in the flask after the determination; eighth, make a temperature correction to the reading of the specific gravity in accordance with the table furnished by the manufacturer of the apparatus, adding the correction if the temperature of the kerosene has increased and subtracting it if the temperature of the kerosene has decreased.

ABSORPTION OF WATER PER CUBIC FOOT OF ROCK.

The absorption of water per cubic foot of rock shall be determined by the following method: First, a sample weighing between twenty-nine and thirty-one grams and approximately cubical in shape shall be dried in a closed oven for one hour at a temperature of 110 degrees Centigrade (230 degrees Fahrenheit) and then cooled in a desiccator for one hour; second, the sample shall be rapidly weighed in air; third, trial weighings in air and in water of another sample of approximately the same size shall be made in order to determine the approximate loss in weight on immersion; fourth, after the balances shall have been set at the calculated weight, the first sample shall be weighed as quickly as possible in distilled water having a temperature of twenty-five degrees Centigrade (seventy-seven degrees Fahrenheit); fifth, allow the sample to remain for forty-eight hours in distilled water maintained as nearly as practicable at twenty-five degrees Centigrade (seventy-seven degrees Fahrenheit) at the termination of which time bring the water to exactly this temperature and weigh the sample while immersed in it; sixth, the number of pounds of water absorbed per cubic foot of the sample shall be calculated by the following formula:

$$\text{Pounds of Water Absorbed per Cubic Foot} = \frac{W^2 - W^1}{W - W^1} \times 62.24$$

in which W = the weight in grams of the sample in air, $W^1$ = the weight in grams of the sample in water just after immersion, $W^2$ = the weight in grams of the sample in water after forty-eight hours immersion, and 62.24 = the weight in pounds of a cubic foot of distilled water having a temperature of twenty-five degrees Centigrade (seventy-seven degrees Fahrenheit).

Finally the absorption of water per cubic foot of the rock, in pounds, shall be the average of three determinations made on three different samples according to the method above described.

ABRASION TEST FOR BROKEN STONE OR BROKEN SLAG.

The machine shall consist of one or more hollow iron cylinders; closed at one end and furnished with a tightly fitting iron cover at the other. These cylinders are to be twenty Centimeters (7.87 inches) in diameter and thirty-four Centimeters (13.38 inches) in depth. These cylinders are to be mounted on a shaft at an angle of thirty degrees with the axis of rotation of the shaft.

At least 13.6 kilograms (thirty pounds) of coarsely broken stone shall be available for a test. The rock to be tested shall be broken in pieces as nearly uniform in size as possible, and as nearly fifty pieces as possible shall constitute a test sample. The total weight of rock in a test shall be within ten grams of five kilograms (11.02 pounds). All test pieces shall be washed and thoroughly dried before weighing. Ten thousand revolutions at the rate of between thirty and thirty-three to the minute, must constitute a test. Only the percentage of material worn off which will pass through a 0.16 Centimeter (1-16-inch) mesh sieve shall be considered in determining the amount of wear.

ABRASION TEST FOR GRAVEL.

The test for abrasion of gravel shall be made with a Deval abrasion machine. (See "Abrasion Test for Broken Stone or Broken Slag.")

A charge of gravel shall consist of pieces which shall pass a screen having circular openings 5.08 Centimeters (two inches) in diameter and be retained on a screen having circular openings 1.27 Centimeters (one-half-inch) in diameter. The total weight of gravel in a charge shall be within ten grams of five kilograms (11.02 pounds). The gravel to compose a charge shall be washed, and dried in a closed oven for one hour at a temperature within five degrees of 110 degrees Centigrade (230 degrees Fahrenheit). The charge of gravel shall be placed in one cylinder of the machine, which shall be rotated at a rate of not less than thirty nor more than thirty-three revolutions per minute. Ten thousand revolutions shall constitute a test. The percentage of material worn off which will pass through a sieve having openings of 0.16 Centimeter (1-16-inch) shall be considered the amount of wear of the charge of gravel. The loss by abrasion, determined as stated, shall be expressed in terms of the percentage of the total weight of the charge of gravel.

TOUGHNESS TEST FOR ROCK OR SLAG.

1. Test pieces may be either cylinders or cubes, twenty-five millimeters (0.98-inch) in diameter, and twenty-five millimeters (0.98-inch) in height, cut perpendicular to the cleavage of the rock. Cylinders are recommended as they are cheaper and more easily made.

2. The testing machine shall consist of an anvil of fifty kilograms (110.23 pounds) weight, and placed on a concrete foundation. The hammer shall be of two kilograms (4.41 pounds) weight, and dropped upon an intervening plunger of one kilogram (2.2 pounds) weight, which rests on the test piece. The lower, or bearing surface of this plunger shall be of spherical shape having a radius of one Centimeter (0.39-inch). This plunger shall be made of hardened steel, and pressed firmly upon the test piece by suitable springs. The test piece shall be adjusted, so that the center of its upper surface is tangent to the spherical end of the plunger.

3. The test shall consist of a one Centimeter (0.38-inch) fall of the hammer for the first blow, and an increased fall of one centimeter for each succeeding blow until failure of the test piece occurs. The number of blows necessary to destroy the test piece is used to represent the toughness, or the centimeter-grams of energy applied may be used.

HARDNESS TEST FOR ROCK OR SLAG.

The test for hardness shall be made with a Dorry or similar machine, consisting of a revolving disc on which is fed, at a uniform rate, a standard quartz sand passing a thirty and retained on a forty-mesh sieve. Two cores, each twenty-five millimeters (0.98-inch) in diameter, shall be cut from the material to be tested, and their faces ground off so as to be at right angles to the long axes of the cores. The cores shall be placed in the holders or dies and weighted so that the entire weight of each core with its holder and added weight is 1,250 grams. Each core shall be ground in the machine on one face for 1,000 revolutions, after which it shall be reversed and ground on the other face for an equal number of revolutions. The loss of weight of each specimen shall be determined at the end of each 1,000 revolutions, and the average loss in weight shall be used for stating the hardness of the material, which latter shall be expressed by the formula:

$$\text{Hardness} = 20 - 1\text{-}3\ W$$

where W equals the average loss in grams per 1,000 revolutions.

(*Continued on page* 54.)



THE USUAL SURROUNDINGS OF BAD ROADS

# More Reasons Why the Boys and Girls Leave the Farm

By Grace Boteler Sanders

A crow, appearing as black as ebony against the pale blue of the sky, shot shrieking from the tall willow the branches of which hung low over the roof of the old judge's handsome country place, now the scene of gloomy activity. Horses, with noses dejectedly down, stood hitched to fences, posts, and trees.

A man stood on the old-fashioned portico with one hand caressed the marble pillar which had seen its beginning in a far-away Florentine quarry. His eyes were set upon the crow as it flew over fields greening under the kiss of the spring rains, over forests and yet on over a smooth, white stretch of road which reached even to the green-shuttered, white meeting-house nestling among lindens which, as yet, only displayed pink buds and naked hoop skirts, but soon to be transformed by leafy green skirts.

An inexplainable gloom had fallen over the place and all nature. When the crow became but a spot upon the dim landscape, the man's eyes wandered back to the gate and a great blot which made him shiver. It was the funeral car which he had brought last night that he might convey the old judge to his last resting place.

"Shure, and it's a sorry day for the country when the old judge died," piped a voice at the man's elbow. When the undertaker's assistant turned he saw the tall, gaunt figure of a man but the face, the wistful, eager eyes, the sweet mouth, the sandy head were, in spite of years, those of a child, a heart-hungry boy.

"Your uncle?" he queried. The boy gave a gulp and swallowed the great lump which had come up in his throat. "No, sir," he quavered. He threw back his head, squared his shoulders, and added with simple dignity, "he's my friend."

The undertaker's assistant felt inclined to laugh at the thought of a friendship between the pompous old gentleman of the picture gallery and this shabby creature. "He built that road to the church," said the boy with admiration in his eyes, but the undertaker's assistant who had been accustomed to city streets which he had left before the spring rains began, did not know that this boy was playing a part; neither did he realize the importance of good roads because he had not been deprived of them. "He built that road," repeated the boy.

"Uhuh," grunted the undertaker's assistant, "that don't amount to much." A stir indoors put an end to the conversation. The boy disappeared. The crowd began to pour out. The undertaker's assistant mentally calculated the number



**"What's the matter with this bally neighborhood? Everything's going to decay."**

which each carriage would carry and gave orders as to their grouping. Once the boy-man with whom he had talked peered from the carriage window and smiled, but the man did not see. The carriage doors shut with a snap. The drivers waited reins in hand. The man mounted his seat just as a little old laborer tottered up and by ridiculous pantomime signified his desire to ride. The undertaker's assistant signified his willingness, and the surprise on his face deepened as the old man climbed to the place beside him and the procession moved on. They reached the church which was filled with old people and babies. There were no pretty maids, no blooming youngsters. Babes in arms, tired looking matrons, fathers, and the tottering old gray beards filled the room.

When they were once more in the car the undertaker's assistant turned to his companion and demanded, "What's the matter with this bally neighborhood? Everything's going to decay! The soil's good, plenty of fruit trees, flocks, herds, houses, but no young people. Everything and everybody is old and out of date. What does it mean? It's positively uncanny."

The old man crossed his knees and leaned over that his eyes might rest upon the engine of the big machine which was chugging and churning its way through the soft mud and slush which they had struck as soon as they left the road which the old judge had built. He had heard what the undertaker's assistant said about the roads and he too waited for the outcome. Every year the March rains came to swell the mountain streams. Their swollen current came tumbing down into the valleys. They thawed the frozen roads and turned them into quagmires.

For weeks eggs and butter and vegetables and other farm products went to waste for want of a market, while the city dwellers suffered for necessities. He knew that the wheels of saw mill and elevator had refused to turn for want of grist. He knew that women and girls and children were kept on the place for weeks while the men on horseback galloped away to do the trading or to enjoy themselves. He knew that asylums and cities had swallowed many and were clamoring for more and that for this reason, the greater part of the rich country had been turned over to undesirables or was farmed by the old. He knew, too, as he watched the machine ploughing along, that trouble was ahead. That it was sure to come. He did not know that this man also was masquerading.

This man at the wheel was not the undertaker's assistant. Senator Jim, the undertaker's brother who fought all rural improvements, who had throttled the road movement in Tuscarawas County and who was planning even greater activity, had arrived the night before and was slated to speak in the county seat on Thursday. When the undertaker and the assistant were both ill and the call to Judge Hanson's came, Senator Jim offered to go. He had not expected anything like this.

With his stern eyes alternately scanning the big tires swishing through mud and water and the splattered sides, the Senator watched the mud which disfigured the sides of the big car, which a short time before, had been bright and shining.

"Where's your young folks?" he demanded exasperatedly. "I'd think somebody would stir things up. Where are they?"

The old man pounded upon his blue-shirted chest. "Me and the boy you was talking to are the young men. There are no young women. They've gone to the city to work."

Hoffmeister gave vent to a sulphurous exclamation, "Fool-headed dunces: they ought to starve," he savagely declared. "Leave those comfortable homes," he exclaimed, glancing at the old farm houses as they passed, "and the fields and orchards and woods for a hall room and starvation on four dollars a week. Young folks haven't any sense. I know what the city is. I was raised there."

They stopped at the cross roads and the young man climbed in. "So was I. The fight got too strenuous and I hiked out here. I was about dead from cold and hunger when the old judge took me in. I helped him build that road but that was years after—"

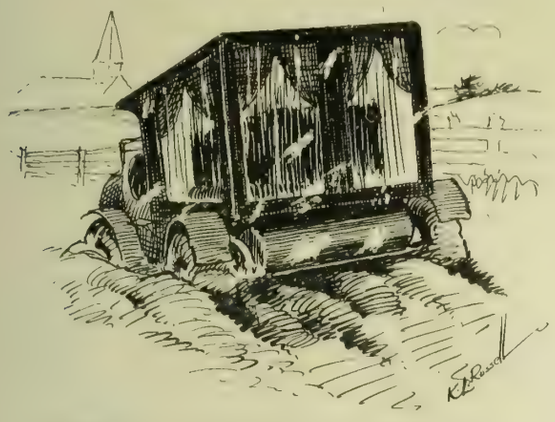
Senator Jim looked back. The lines of carriages had dwindled to one with several horses following. "Where in the deuce has the procession gone?" he wrathfully demanded.

"Fell through," grinned the boy-man.

"You say you have lived both lives and chose the country as every sane man should? Now tell me why the farms are depopulated, houses empty, and fields bare of the produce which is needed to feed the world. Tell me."

"I told you and you laughed at me," interrupted the old man, "it's these pesky roads.'

Rats!" Hoffmeister's sulphurous sentence was never finished for the machine rose suddenly and came down with a chug which made every lamp and screw and chain rattle. Senator Jim swore roundly. He put on all the power, but the auto only chugged and pulled and strained and stood still. Ahead were the towers and buildings of Tuscarawas toward which the funeral procession plodded. It was scarcely a mile but around, behind, before, was a sticky sheet of mud which was insurmountable. Senator Jim gave another jerk. The engine died. There was nothing to do but crawl out into that seething sea and stand while he cranked the auto. And he wore shining patent leather shoes instead of boots!



Marooned on Mud Island with the Judge's body.

The air tuned blue, yellow, green. The machine chugged and groaned. The first carriage and the men on horseback came up and offered their assistance. They worked and tugged and lifted and the young man, who was one of wisdom, in spite of his lack of years, laughed, for he knew that Senator Jim was to receive that day, his lesson.

The shades of evening came. The mourners drove on to town and sent back help and finally when all was in vain, Senator Jim and his assistants took the heavy casket and after many trials carried it across the Rubicon of mud and placed it in a wagon, drove on, and left the big machine to be cared for by more competent hands.

The little old man went with the Senator to the undertaker's home and after a bath and a change of clothes and a warm supper, they went out on the porch to see the machine towed in. When it was safe in the garage, Senator Jim turned to his companion and laid an earnest hand on his shoulder. There was a twinkle in his black eye, an earnest, wistful appeal which might have been borrowed from the boy, so like the expression of the morning was it.

From out the dim light of the spring evening, the street lamps twinkled and occasionally cast gleams of light upon the serious face of the man who had so lately become a learner. "I am beginning to see a gleam but I want you to put on the flash light that every point may be made clear. What occurred in the old judge's life which set him to building roads? I am an unbeliever but I am willing to be shown that I am wrong, if I am. That experience this evening was," Senator Jim puffed at his cigar, "ghoulish to say the least, but, of course, that happens but once in a lifetime. I noticed six, lovely deserted houses from which I am told six children each have gone cityward. Why?"

"Farmers don't treat their children right." The man's eyes gleamed bright under the kiss of the street light. "I have seen both sides," he gave his head a defiant toss, "and I know. Don't they put the boys and girls to work as soon as they are big enough and keep 'em at it so long as they can drag and without a cent of pay? I heard one of the men who owns that biggest house rave when his son asked for twenty-five cents to buy a song book. That fellow had been putting in sixteen hours a day in the field."

"A QUARTER?" Senator Jim reflectively took the fragrant weed from his mouth and with one eye squinted, gazed at the red rim, topped by ashes of soft gray. "Refused a boy who had labored sixteen hours at the grinding labor of the farm, the price of this cigar which would have bought a song book, a collection of melodies lilting, serious, gay which would have made his hard life more endurable!" Senator Jim could see the boy early at the plow and hear him shouting the songs which that book had taught. He tried to calculate the cost of the cigars which he consumed each day. Failing in the attempt he threw the weed aside and lighted another.

This boy could earn at least twenty-five cents an hour in the city. Sixteen hours would have given four silver dollars for one day, yet when he worked as many days for his father, he was refused the price of a twenty-five-cent song book. He must have been a Scrooge.

"There are few men of that stamp in the world," haughtily declared the Senator. Before a reply could be framed, they heard a rasping, complaining voice in the street below.

"I don't know what to do. I bought that farm with the expectation of the boys helpin' pay for it and I stocked up with cows and a separator so as to keep the boys busy. They grumbled a lot 'bout getting up early winter and summer but 'twas no earlier than I got up when I was a boy. What happened?"

"Why the very last one of the six boys flared up to-day and told me, 'he'd be consarned if he was a going to dog his life out milkin' cows early and late every day and Sunday too, when you could go to the city, have Sunday and evenings off and work five and a half days at good pay. He went, too, the white-livered scoundrel, and I can't get a man or woman for love or money to do what that boy did.' "

"What did you pay him?"

The silence was freighted with meaning, then the old man snarled out: "PAY. Wasn't he my own flesh and blood and didn't I feed and clothe him?"

"What kind of clothing did he have?"

"A good pair of overalls, stout shoes, a blue shirt, and a straw hat. That's good enough for anybody in warm weather," snapped the father.

"Few boys dress like that these days," remarked the stranger, "but I suppose he preferred to do that and bank his money."

"He didn't have no money to bank and he didn't have no fine clothes. I'm no millionaire. I'm trying to pay for a farm and I expected the pesky boys to help, but now I'm out."

"How many acres have you?"

"Six hunderd, if I ever get this paid for." The two men on the veranda noticed the sternness of the other man's tone.

"If you had paid your boys for their work and been a father instead of a despot, they would have yet been with you."




Too stingy to build roads or pay his boys for their labor.

The father savagely shouted: "Let 'em go to the city and rot for all I care. I'll be boss of my own house and my money so long as I live, but you needn't blame their leaving on me. They fussed because the roads were so bad that they couldn't drive to town with their marketing when they liked. If you blame me for that I'll remind you that the Almighty makes the weather."

"He don't make the roads. Men have for ages been doing that. They are learning modern methods and using them

and profiting financially and socially. The reason youngsters leave the farm where they are denied all social, educational, and spiritual advantages is because of such men as you, who are too stingy to build roads or allow the boys a fair compensation for their labor. Treat them as good as animals and they will stay with you."

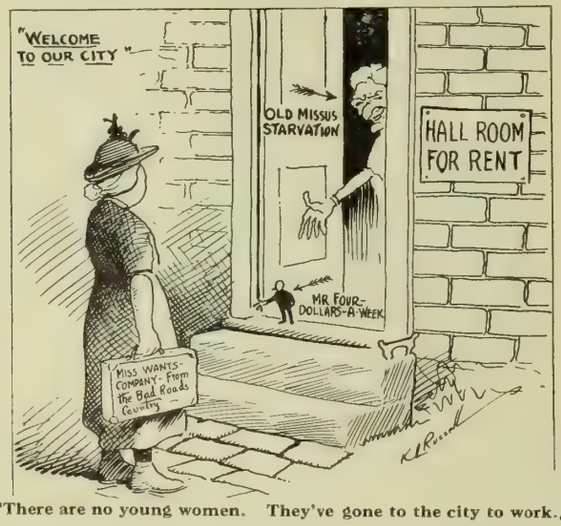
"You are a fool!" shouted a voice, and when the receding footfalls announced that the men were really gone, the Senator turned to his companion. "He's only one," excused Senator Jim, "but I'll declare, these roads are enough to give any one the woolies. Now what about the old judge?"

The old man leaned over the railing and looked moodily down into the street. "The judge was a fine old man but he was terribly sot," sighed the man, "that house is fine too, was built out of brick what came from England and the marble come from Florence and the rugs from Turkey and the paintings from Rome. He raised six children. They was taught to think themselves better than other folks, had private teachers at home and all that. They grew up as innocent and secluded from the world as if the house were a baronial castle. The judge and his wife was satisfied but after awhile, when the children grew older, they grew tired of their own company and the servants. They wanted to go to school and church and to picnics with other young folks.

"They had no way of getting money. Eggs and produce could not then be sold for want of a market. About the time that they had concluded they could not stand it any longer, the building of a pike was proposed. The judge's youngsters were enthusiastic; the people of the county anxious for the measure. The judge fought it to a finish. He was the largest landowner and had the slickest tongue so it was not hard for him to swing things his way. That night Jim and his father had a tongue fight. He left the next day and his father told him that he should never return."

Senator Jim had forgotten all else except the tragic recital of a life. He sat with his cigar, looking moodily out at the quiet street. "If the judge cared, he did not let any one know it," continued the old man. "He grew even more strict and taciturn and two years later, the second son followed Jim from whom they had not heard. He took their pictures from the gallery which contained the likenesses of generations and packed them away. He did not mention them again. But though the old judge had once triumphed he could not do it again. Roads were built all about him, but he frowned from his plantation and over the stretches of mud which kept his family shut off practically from the world. The mother died. The children grew up, argued, pled, and when all these things were useless left as Jim had done, until only Henrietta, the pretty daughter, remained."

Senator Jim struck a match, lighted his cigar and puffed energetically. "You'd a thought he'd a been extra kind to her who was so dainty and sweet and affectionate like her




"There are no young women. They've gone to the city to work.."

mother, but the old judge was as hard as a piece of iron. He wouldn't let her have a cent of money for fear she'd go too. She had no decent clothes, lest some young man be attracted and marry her. He didn't take her to picnics or parties or let her go to church but he watched her like a jailor and Henrietta got tired of it. One morning the old judge found her gone and he found a letter, too. "Dear father, I cannot stand it any longer. I will never return until a good road connects us with the outer world and I can be a free American girl with friends and associates and privileges of church and school."

"And I suppose he allowed her to go!" sneered Senator Jim.

"He did. He thought she was too timid to find work and that she'd come crawling back but when a month and six months and a year passed, he got uneasy and sent detectives on the track of her and when they gave up the old judge changed his tactics. 'I want to have the road done when Henrietta gets here, so I'll have to hurry,' he told the contractor. He got an army of teams and men and building materials. He superintended every bit of the work himself 'for Henrietta's particular,' he said, 'and we must hurry for she will want to go to church as soon as she gets home.' But she did not come. Six months after the road was finished, he had word that the boys and their families had perished in the Galveston flood, but the old judge never stopped watching for the daughter."

"Did he never find her? To whom does the property go? Was the work in vain?"

"No, for it aroused the whole country, and they are beginning to see. Henrietta's son, the young man to whom you were talking, has been stirring things some. He's been studying engineering in the Columbia University. His grandfather was that proud of him. The Honorable Henry, he was named for his mother, has been making road speeches everywhere. He's a regular holy terror. If that $5,000,000 bill don't pass this election, by gee, the lad'll build roads himself!"

Senator Jim stroked his chin reflectively. The Honorable Henry! This sandy-headed boy, the man who had been convulsing two continents with his convincing arguments, his hot-headed speeches, his telling satire! this boy, heir to the old house, the priceless bric-a-brac, the pictures and the old judge's honored name. Senator Jim, who had as bitterly fought upon the opposite side, saw in fancy his house of cards tumbling about him.

From the moment, when he had been marooned on a mud island with the judge's body as the leaden moments dragged, though the explanations of hardships and stories of sacrifices, he had known that he was as pig-headed as the old judge himself. The old man had given up. So would he.

To-morrow was the day set for the great political meeting when he and the Honorable Henry would plead their cause before the people. He said good night to the old man and went to his room but he could not sleep. He took out the typewritten manuscript of his speech and re-read the arguments which he had considered so telling but he saw instead, the boy who had pled for a twenty-five-cent song book and the dairyman and the five sons and dainty Henrietta.

"By gee, I'll never give it," he shouted and brought down his fist upon the table with a bang, "not if I die for it. I guess I've a right to change my mind if I like."

The morning came bright and sunny and filled with flowers. The town filled rapidly with vehicles and people but Senator Jim did not go to the grandstand until the Honorable Henry's red head towered above those of the rest. The music surged and swayed. The younger man made his convincing, heart-breaking, appealing plea. He was much astonished when he saw the undertaker's assistant of yesterday upon the platform. He was more surprised to hear him introduced as Senator Hoffmeister, the political cyclone.

When Senator Jim stepped to the front, the young man braced himself for the withering, cutting sarcastic sentences for which the man was famous. But he was smiling! The tails of his handsome black Prince Albert coat were swaying with merriment.

"I have heard of reformers who give advice on subjects of which they know little, but I always thought I knew what I was telling," he began, "I was to have talked on, 'Why youngsters leave the farm.' Since being in your midst my sentiments have so changed that I scarcely recognize myself as the man known as Cyclone Jim. Why do the youngsters leave the farm?

"In three-fourths of the cases, it is because parents are too pig-headed, too stingy to give them even the advantages which they shower upon their beasts. Housing, feeding, training of horses and hogs and sheep are important. The boy must take what he can get. I have said many times that the man who changed my ideas on the road question would be a dandy. He is. Let me again introduce you to your fellow townsman, the Honorable Henry."

Yells and cheers interrupted. The young man hesitatingly advanced, then Senator Jim took his hand, "Hereafter we work together for the cause of Better Roads," he said:

"If you wish to make your children happy,
If you wish your wife to smile,
If you wish to pile up dollars and be joyful all the while,
Build good highways to your churches—
Build good highways to your schools,
Drive out crime and all deceiving,
Make all perfectness the rule.
Then your boys will leave the city,
Then your girls will all return,
To the home, the dear old farmhouse
For which all these years they've yearned.
If you wish an earthly Eden
Here upon this world of strife,
Build good roads—NOW.
Quit your fooling,
And be happy all your life."

Oh, how they cheered when they two, who had been enemies although they had never before met, grasped hands! How every one crowded forward. Honorable Henry introduced Senator Jim to many and lastly to a fair and gracious woman whose smiling, red lips and proud, blue eyes and stately little head, covered with brown braids, and soft sweet voice, proclaimed her as a gentlewoman.

"My mother, Senator," began the young man. For a moment Senator Jim forgot himself.

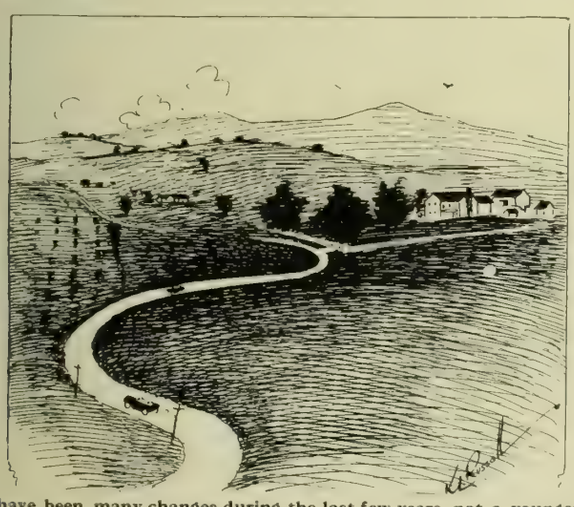
"Not Henrietta?" he queried.

"Yes, Henrietta," blushed the lady. "Why?" The fiery, black eyes watched her so admiringly that she could not do other than blush.

"But Henrietta went away and never returned."

"I guess you are mistaken for I am Henrietta and I did return. I don't feel at home elsewhere."

"I don't blame you. It is charming," declared the Senator, looking straight into Henrietta's face.



**There have been many changes during the last few years, not a youngster has gone to the city for employment.**

The new road was finished five years from that day. After the dedicatory exercises were over, the Senator and Henrietta entered a shining machine and slid away from the crowd and down the shining highway which led directly into the gold and glory of the sunset. Both were quietly, exultantly happy. The Senator's eyes were set upon a crow which was like a blot of ebony against the sky. In unerring flight, he followed the white road and even to the green shuttered, white meeting house which nestled among the lindens. It reminded him of another spring day when an ebony bird had fled, shrieking down the way.

"There have been a great many changes during the last few years. Not a youngster has gone to the city for employment and many have returned and settled down to live the simple life," mused Henrietta.

Senator Jim brought the car to an abrupt stop. "There'll be more, if they get any encouragement." He spoke with finality. "Henrietta," he took her hand and grabbed her to his heart, "I've been an anti-road man. I've despised the country and extolled bachelorhood, but I feel as if every prop had fallen from under me. I adore the country. I am mad with love of you. I am crazy to renounce bachelorhood and become a benedict.

"You are too young and beautiful to live here alone. Why can we not enjoy life along the highway which Henry and I built because of the seed you planted years ago. Few women live to see their ideals materialize or their reforms inaugurated. You have, but you still need a companion. Henrietta, couldn't you love me just a little and marry me?"

"I have loved you for five years," shyly confessed Henrietta, tucking her hand under his arm and so they spun on and on through the fragrant twilight to the musical humming of the motor which was carrying them swiftly along over the road which love had built.

* * *

## Chemistry, Manufacture, Transportation and Control Testing of Refined Coal Tars

Philip P. Sharples, Manager and Chief Chemist, Tarvia Dept., Barrett Manufacturing Company of New York

THE past year has perhaps been the most remarkable in the history of the coal tar industry in the United States. The shutting off of imports of creosote oils, the unprecedented demand for benzol, toluyl, and phenol in the manufacture of products previously imported but now exported on an enormous scale, the closing of the market for export pitch have all brought problems which had been forecasted for the dim future but which have clamored for solution not in the space of years but in the space of months and weeks.

Economists in the field of the coal and coke industries have long deplored the great waste involved in the process of coking with the beehive oven. Of thirty-four million tons of coke produced in 1914 more than two-thirds were produced in the beehive oven and all the gas, all the tar, and all the ammonia wasted. One year and a half of war has led to the initiation of plans which will increase by 200 per cent. the coke produced in by-product coke ovens. Incidentally, the tar produced by recovery coke ovens will rise from two and one-half million barrels to six and one-half million barrels. As at the present time the coke ovens produce half the tar in the United States, the increase, if all the plans are followed through, will result in doubling the output of tar in the United States.

These great changes cannot help but have a profound influence on the development of the application of coal tar materials in the building and treatment of roads. The industry, which has grown by leaps and bounds in the last decade, cannot but be stimulated by these new sources of supply of the raw materials.

The history of the use of tar for road purposes is intimately mingled with the early history of gas making on an extensive scale. Great numbers of experiments were made in the endeavor to use coal tar for road purposes and the Patent Office shows great activity both in the direction of making improved coal tar materials and in methods of construction during the period of 1850 to 1880. Some of these older methods have survived, and at the present day in New England the so-called tar and gravel concrete is still being laid. The best of this work was laid with raw tar roughly refined on the job in open kettles mixed with coal tar pitch furnished by the tar distiller.

The modern extension of refined tar for road purposes is of recent origin and dates back only to 1901. The modern use of tars for road work began from the surface, and in consequence the materials developed were far different from the materials used in the earlier construction work. The new industry rapidly became of so much importance that it was given close study both by users of road materials and by manufacturers. Its development along scientific lines has been rapid and the industry is now on a firmly established basis.

Lecture in the Graduate Course in Highway Engineering at Columbia University delivered on December 30, 1915

Particular objects of scientific study have been the tars which furnish the raw material for the road material and the methods of testing which control, not only the raw tars, but the finished product. The study of these problems has reacted on the whole tar industry and to-day not only are the road tars subjected to close scientific control, but the whole product of the tar refiner plant, refined tars, pitches, oils, and their various modifications are subjected to close laboratory control. Laboratories are now considered an essential requisite of every first-class tar distilling plant. One manufacturer maintains a Research Laboratory conducted on highly scientific lines where problems not connected with a single plant but of benefit to the whole industry are studied.

The raw tars available for refining for road purposes are roughly classified into coal tars and water-gas tars. The two raw materials differ essentially in chemical and physical characteristics, and the road tars made from them show similar variations. By far the largest amount of tar refined for road purposes is, however, made from coal tars. Water-gas tar usually requires some modification with other bitumens in order to make them available for road purposes. Coal tars, themselves, are further divided for purposes of classification into several groups according to their origin. The different groups vary greatly in composition and this difference is not alone marked between the groups, but also is marked between individual samples in the same group. The characteristics of the groups are well shown in the following table:

TABLE NO. 1.
COMPARATIVE ANALYSIS OF TARS.

| Tar from | Specific Gravity at 15.5°C | Specific Viscosity Engler 100C | % Free Carbon | % Oil to soft Pitch | % Tar Acids on Oil |
|---|---|---|---|---|---|
| Horizontal gas, 16th St. | 1.293 | 30.0 | 37.5 | ... | ... |
| Horizontal gas, Astoria | 1.267 | 21.8 | 28.9 | 13.2 | 14.0 |
| Inclined gas, Astoria | 1.238 | 14.9 | 24.3 | 14.3 | 21.0 |
| Semet-Solvay coke oven, Lebanon, Pa. | 1.187 | 3.0 | 10.8 | 21.8 | 4.0 |
| Vertical gas, Providence | 1.153 | 2.1 | 4.0 | 28.8 | 29.0 |
| Water gas, Ravenswood | 1.074 | 1.6 | 0.3 | 45.1 | ... |

TABLE NO. 2.
COMPARATIVE ANALYSIS OF PITCHES.

| | Specific Gravity at 15.5°C | Melting Point, Cube Water | % Free Carbon | % Fixed Carbon | % Ash |
|---|---|---|---|---|---|
| Horizontal gas, 16th St. | 1.357 | 127°F. | 46.1 | 51.5 | 0.14 |
| Horizontal gas, Astoria | 1.306 | 131°F. | 33.5 | 42.0 | 0.21 |
| Inclined gas, Astoria | 1.284 | 130°F. | 30.4 | 37.9 | 0.10 |
| Semet-Solvay coke oven, Lebanon, Pa. | 1.281 | 133°F. | 19.3 | 28.8 | 0.48 |
| Vertical gas, Providence | 1.225 | 145°F. | 10.4 | 19.1 | 0.23 |
| Water gas, Ravenswood | 1.190 | 139°F. | 1.1 | 23.8 | 0.06 |

An analysis of water-gas tar is appended for comparison. It will be noted that there is a great difference in specific gravity, the specific viscosity and the per cent. of free carbon and that these vary in somewhat the same way. While this accord in the variations is marked in the type of samples taken, it is not universally true, and we may have samples in which the variations would not fall in the same place in the different columns, although there are no very marked diversities. You will note also that the amount of oils produced when the tars are distilled to a soft pitch varies inversely. This also is subject to individual variations although the general quantities yielded vary as indicated. In the tar acids produced, however, it will be noted that the different tars show no gradual variation. The one marked feature of the column is the absence of tar acids in the water-gas tar oil; but even here samples may be found which have small percentages of acid. It is also possible to obtain coke oven tars which contain a large percentage of tar acid.

The inference is readily made that with such variable raw materials, it is not possible to make a uniform product without a command of a large variety of tars and without very close laboratory control.

It is interesting to compare with the table of analysis of raw tars, the table of analysis of pitches produced from these same tars. This is given in Table 2. You will notice in this table that the specific gravity of the pitches and the free carbon follow in the same order as in the tars. As in the case of the tars, this need not necessarily be so, as individual variation will occur if enough samples are examined. The general trend of the pitches, however, is to fall into the order indicated.

The fixed carbon, this must not be confused with the free carbon, also advances in order; but the ash, on the other hand, has little relation to the process employed and probably depends more upon the kind of coal used to produce the gas.

An examination of the table further emphasizes the importance of strict laboratory control of both the raw material and the product of a tar distillery.

The oils produced from the different tars are quite as different as the pitches. This subject has, however, been already covered by others in this course of lectures.

Examination of the apparatus used in the production of these various grades of coal tar seems to indicate that a large part of the variation is due to difference in temperature in the retorts used for making the gas, or a difference in temperature of the passages through which the tar and gas escape from the retort. In the gas house, for instance, the retorts are small, holding only 400 to 600 pounds of coal, while the temperatures are kept very high in the endeavor to obtain as great a yield of gas as possible from the coal. These high temperatures bring about much decomposition in the bituminous materials formed in the destructive distillation of the coal with a consequent production of free carbon and the yield of more gas. On the other hand, in the coke oven, the units are large. The retorts hold six tons or over of coal and the passages for escape of gas and tar are large, ensuring a low temperature, not only in the production of the gas and tar, but also in its passage out of the apparatus. The vertical retort tar still further illustrates the affect of temperature.

A study of these tars also develops the fact that at low temperatures there is produced a certain percentage of unsaturated hydrocarbons, thus giving an interesting clew to valuable research on the method of production of tars in the retorts. The tar is carried from the retorts in a stream of gas. As soon as the temperature begins to fall, the tar is deposited. In the gas works, a long inclined gas main, known as the hydraulic main, takes care of the products of the retort, and in this the bulk of the tar is deposited. With the tar are mixed water vapors and ammonia. Even after the temperature of the gas, by passing out through cool condensers, has been brought below the condensing point of the tar, it still carries a considerable percentage of tar with it owing to the extremely fine state of division of the particles of tar. These particles are further taken out in some type of tar extractor which usually uses baffle plates so arranged that the current of gas is frequently interrupted so as to throw the particles of tar together and cause them to coalesce. The tar collected from all the different points is brought together into a separate tank and allowed to settle to separate the ammonical liquors from the tar. This separation is expedited by keeping the tanks warm and by transference from one tank to another after the tar has settled partially in the first tank.

The tar is now ready for the tar distiller and is transported from the gas plant to the tar plant by some one of the modern forms of transportation. Where the gas plant is near a tar plant, it is permissible to use a pipe line as in the petroleum industry, but owing to the necessity of keeping the tar warm while running it through the line, the length of the pipe is somewhat limited.

In railroad transportation, standard tank cars of 10,000 gallons capacity are used. These are equipped with steam coils. For water transportation, barges which vary from those of small capacity for use in harbor work to large vessels holding 300,000 gallons are used.

On its arrival at the refiners the tar is pumped from the tank cars or barges into a storage tank. During the process of pumping it is sampled and the analysis forms the basis of the future disposal of the tar.

The method of sampling has been a problem of great difficulty. The tar as it arrives at the works contains often a

considerable percentage of water and it is well nigh impossible to obtain a sample which shall accurately represent the total shipment. The best solution up to the present time has been the insertion of a thief pipe into the riser of the pump. Experiments have shown that the position of the thief pipe in relation to the center of the discharge pipe is important, since different percentages of water are collected as the position is moved from the circumference to the center. A compromise has been made and the pipe placed half way to the center.

Storage tanks of 250,000 gallons to 2,000,000 gallons capacity are provided for the storage of different classes of tar. A first-class tar plant requires a large number of tanks, both for the storage of raw tars and for the reception of oils produced in distillation. Storage tanks must be of heavier construction than that required in the oil industry, since the tar is immeasurably heavier. Steel is used for the body of the tank which must be rested on foundations well built with concrete and piled heavily when necessary. The roofs are best constructed of timber with tar and gravel roofing covering. It has been found that the wood is of very long life owing to the preservative affect of the vapors, while on the other hand, the steel corrodes easily and must be often renewed. Tanks are provided with side outlets at intervals to allow removal of surface water without disturbing the contents of the tank. They are also provided with steam coils which not only serve to heat the tar, but also to mix it thoroughly through convectional currents.

The actual refining of the tar may be separated into three headings: the dehydration, the blending, and the distillation.

Dehydration is accomplished roughly by settling. The tars from different gas works vary greatly in the percentage of water retained after settling. With some it is possible to reduce the percentage to below two per cent.; in others, the amount remaining will be upwards of ten per cent. It is important from the tar distiller's standpoint to reduce the percentage to as low a point as possible, since the removal of water from a tar containing even less than five per cent. requires more fuel than the entire further distillation to a hard pitch. Much study has been expended on apparatus for dehydration. While much has been accomplished, no perfect dehydrater has been produced. Enough has been done, however, to very materially reduce the expense of dehydration. The tar, when dehydrated as much as the facilities of the plant permit, is then pumped into the still. Chance is now given to so blend the tars that a uniform product may be produced or a product fulfilling some definite specification. The process of blending is one that requires an absolute knowledge of all the tars carried in stock in a plant and a knowledge of their action in distillation. It is not always possible to detect from laboratory experiments the final product of distillation, since changes do not always take place when conducting distillation on a large scale as take place in the laboratory. The amount of decomposition in the still, for instance, varies greatly with the size of the apparatus. The distiller must also study his own plant as the rate of distillation also plays an important part in the results. The nature of the charge is now controlled by the laboratory and the laboratory is responsible for the results obtained.

The stills used in this country very generally are of steel and are cylindrical set horizontally. This differs markedly from foreign practice, where the small upright still is preferred. Abroad, however, it is important to run off the charge quickly in one working day, while in American refineries, the process is carried on through the whole twenty-four hours. The labor economy resulting from large stills is important, while the slight saving in fuel of the vertical over the horizontal is of less moment here than abroad. Recent improvements in the setting of horizontal stills has, however, made them close rivals to the vertical still in economy. The stills are very generally set in brick with fire arches to protect the bottom of the still from the direct action of the heat. Direct heat on the bottom is apt to cause a deposit of coke on the still bottom which, if not removed, will cause rapid deterioration of the plates. Various forms of fuel are used from natural gas through oil fuel to coal or coke. The relative efficiency is a matter of economic study for each plant. The oil and gas fuels, however, allow a much closer regulation of the heat and are in that way a decided advantage.

The distillation of a charge varies from [illegible] for a small still running on dehydrated tar to twenty-four hours for a large still running on hard pitch. The distillation is begun slowly as great care is necessary in order to prevent frothing due to the quick liberation of the water in the tar when a critical point is reached. A still when is once begins to froth is difficult to control and the entire contents of the still may be expelled before the frothing can be stopped

The water and light oils are first driven off and are condensed in the worm which is immersed in a tank of cool water The condensed water and oils fall into measuring tanks, where they are separated and run into storage tanks. After the light oil has ceased running at about 170° C. the distillation practically ceases for a time and it is necessary to very materially increase the heat before it commences again.

Next the carbolic oils come over which are now separately collected in most plants, and finally the heavy oils come over. These different oils furnish the raw product for the manufacture of benzol, toluyl, and xylol, and the manufacture of carbolic and cresylic acids, and for the production of creosote oils for preservative purposes. This part of the industry has already been described.

The nature of the product left in the still can be roughly judged by the number of tubs of oils which have been removed. The exact consistency must, however, be determined. The stills are provided with draw-off cocks and samples are taken from time to time for testing in the laboratory as the end point approaches. Considerable skill and knowledge of the individual plant are required in order to make the still sample tally with the sample of the finished material after it has been brought to air temperature. A constant checking alone ensures successful testing.

For light road tars distillation is early stopped. For binder purposes, the distillation is carried much further, and for pitches used in filler work, the distillation must be carried much further and precautions taken to ensure against the injury of the stills through deposition of carbon and consequent local overheating. The agitating of the contents of the still is necessary, either mechanically as in many foreign plants or through air agitation as practiced in this country. The introduction of air also tends to hasten the distillation as the higher temperatures are reached.

After the still is finished, it is blown either by air pressure or steam pressure from the still into coolers. These are of various types. Those used for barrelling are usually small steel tanks, so situated as to allow a free circulation of air about them. As soon as the refined tar or pitch has cooled sufficiently, it is run off into barrels and further cooled before shipment.

For tank wagon shipments from the plant, much larger coolers are employed as it is here important to keep the material warm rather than to allow it to cool. Coolers of this type are usually provided with fire boxes and the contents kept at some given temperature ready for shipment to the road.

Tank cars are filled sometimes directly from the stills after some cooling in the still or from an intermediate blowing tank where cooling takes place.

Tank wagons are usually fitted with fire boxes in order to keep their contents hot, while auto trucks are usually equipped with steam coils in order that the material may be heated if it becomes cool in transit. Auto trucks with oil heaters are also in use.

Tank cars are provided with coils which are figured of a capacity sufficient to heat the tank car in eighteen to twenty-four hours under ordinary conditions with a steam pressure of eighty pounds. Usually, a fifteen to twenty h. p. boiler is required to adequately heat a tank car. Under favorable conditions the contents may be heated to 220° F.

Refined tars are manufactured to many different specifications. Materials have, however, in the last few years, become more or less standardized, and the letting specifications now most often used call for very similar materials for the different classes of work. The points now generally covered in a specification are the specific gravity, viscosity or melting point, free carbon, distillation. With distillation, it is also customary in the best specifications to report the specific gravity of the distillate and the melting point of the remaining pitch. Some specifications also cover ash, the percentage of naphthaline and freedom from water. The latter point is covered

under distillation and is superfluous. The ash is of minor importance. It is perhaps well to specify a maximum to discourage attempts at adulteration. The specific gravity is of importance as it shows to a certain extent the origin of the crude tar. It should not, however, be confused with viscosity as the specific gravity and viscosity are only related when the tar serving as a base is the same in both cases. In defining specific gravity, the method used should be stated clearly, especially the temperature at which the comparison with water is made, usually 60° F. is specified, but many specifications call for 25° C.

The viscosity or melting point is a very important point in refined tars and must be very carefully specified. It is the one most important point. It has nothing to do with the origin or composition of the tar, since any tar may be brought to a given viscosity or melting point above certain lower limits. There is much variety in the methods of specifying viscosity and melting point. For materials liquid at ordinary air temperatures and for materials which are easily fluid at the temperature of boiling water, the Engler viscosimeter is most commonly used. The standard method is, however, departed from in that 100 c. c. is generally specified to be run off rather than the usual 200 c. c. with thinner materials. The smaller amount tends to greater accuracy, since with heavier materials there is much lag in the running out of the last 100 c. c. Much time is also saved in making the test. The temperature at which the test is specified to be done makes much difference in the latitude allowed in manufacturing. The temperature for the material should be so chosen that there should be considerable latitude between limits of viscosity allowed. It is customary to specify the viscosity of material for cold application by the viscosity of 60° C. Materials for hot surface treatments are generally specified at 100° C. The viscosity of materials for hot surface application may, however, be specified by the float test or the Schutte penetrometer. Under these circumstances, with the float test, 32° C. is an acceptable temperature. With the Schutte penetrometer, the temperature should be so chosen that the test is 100 seconds. With the usual grade of material specified for hot surface treatments, this would be 40° F.

The viscosity of binders is generally regulated by a melting point test or a float test. The most commonly used melting point test is the cube method in water. Departure is, however, made from standard methods in that the initial temperature is 40° F. instead of 60° F. The float test is best performed at 50° C.

Free carbon has caused more discussion than any other item in the specifications. Those who had experience with coal tar for roofing purposes and water-proofing were confident that a certain percentage of free carbon was essential to a successful road material. Those looking at the problem from a theoretical standpoint, took the ground that the free carbon was an inert substance and could therefore only be of negative value in a refined tar. A large number of experiments carried on to determine this point have seemed to indicate that tars very low in free carbon were too much affected by temperature and also were more subject to change under atmospheric influences than tars which contained a fair amount of free carbon. Experience has seemed to settle that a moderate amount of free carbon is beneficial in a road tar thus bearing out the practical experience gained in the use of coal tar materials in other directions. At the same time, an excess of free carbon is not desirable, since it tends to make the material difficult to work and also reduces to a considerable degree the amount of true bitumen available. On the other hand, a certain percentage of free carbon seems to enhance the binding power of the refined tar. The upper limit may perhaps be set at twenty-five per cent. for a binder and perhaps twenty-two per cent. for a tar used for hot surface application. The lower limits on these classes of materials should certainly not be less than twelve per cent. for binder materials and ten per cent. for hot surfacing materials. With cold surfacing materials the free carbon is necessarily much lower, as its presence in large quantities reduces the penetration. With cold surfacing materials four per cent. may be placed as a desirable minimum.

The distillation test has been the cause of much difficulty. It was attempted in the early days to define the viscosity by the distillation test. This it was soon found was impossible, due to allowable variations in the distillation over somewhat wide limits, due to other variations in the tar. No test is more susceptible to variations in method than the distillation test, and any specification must absolutely define every point of the distillation. The test as defined by the American Society for Testing Materials, is perhaps the most widely adopted at the present time, and serves as an excellent model. Much more is told by the distillation test if the specific gravity of the distillate and the melting point of the residue are also called for. A close definition of these two points excludes the possibility of materials made by cutting back a hard pitch with a comparatively light oil. Excluding distillates below 170° C. precludes the presence of water. A certain percentage of distillate under 170° C. is, however, allowable in the case of materials for cold application, since it is desirable to have present a certain amount of light material to allow for the evaporation and hardening of the crust. The upper cut is best made at 300° C. The amount specified to be distilled over at this temperature is not as important to specify as the specific gravity. The amount distilled over will vary with the other parts of the specification. It must be borne in mind that results specified by one method of distillation do not correspond with the results obtained by other methods.

Great care must be exercised in drawing specifications to correlate every part. A change in one part of the specification necessarily changes the limits in the other items specified. For instance, changing the free carbon changes the specific gravity; changing the distillation, changes the viscosity. Before any specification is finally adopted, it should fill the following requirements: The material must be capable of manufacture at reasonable cost. The material, if showing any radical change over materials already in use, must show merit through actual road use. The specification should be proved up by actual analysis of samples furnished by reputable manufacturers. The figures to be actually specified are still subject to change through knowledge gained by the actual road results of tars already in use. The consensus of opinion, however, seems to indicate the following values as safe for the different classes of materials, which for the purpose of specification may be divided into four classes:

1. Binders or refined tars used in the construction of macadam roads.
2. Refined tars for use in road blanket treatments.
3. Refined tars used in cold surface treatments.
4. Refined tars or pitches used as filler in block pavements.

*Road Binder*:

Specific gravity at 60° F. not less than 1.20. It is not necessary to specify the upper limits since this is controlled by the free carbon.

Viscosity, melting point (half-inch cube method in water), 100 to 110° F. or float test, two to three minutes at 50° C.

Distillation: Method of the American Society for Testing Materials. Nothing below 170° C.

Not more than twenty per cent. below 300° C.

Specific gravity of the tar distillate to be not less than 1.03 at 25° C.; residue from the distillation to have a melting point of not greater than 75° C. (cube method in water).

Free Carbon: Not less than twelve per cent. nor more than twenty-five per cent.

*Refined Tar for Hot Surface Application*:

Specific Gravity: Not less than 1.19 at 60° F.

Viscosity: Engler—100 c. c. at 100° C., 125 to 200 seconds.

Or float test at 50° C., thirty-five to sixty seconds; or, at 32° C. not less than two nor more than three minutes.

Distillation: Method of American Society for Testing Materials. Nothing below 170° C., not more than twenty-four per cent. below 300 ° C.

Specific gravity of the tar distillate to be not less than 1.03 at 25° C.; residue from the distillation to be 75° C. (cube method in water).

Free Carbon: Not less than ten per cent. nor more than twenty per cent.

*Refined Tar for Surface, Application Cold*:

Specific Gravity: Not less than 1.14 nor more than 1.18 at 15.5° C.

Viscosity: By Engler viscosimeter, not less than 150 nor more than 300 seconds, for 100 c. c. at 40° C.

Distillation: Method of American Society for Testing Materials, not over five per cent. below 170° C., not over thirty-two per cent. below 300° C.

Specific gravity of the entire distillate shall not be less than 1.01 at 25° C.; residue from the distillation to have a melting point not greater than 70° C. (cube method in water).

Free Carbon: Not less than four per cent. nor more than twelve per cent.

Tables 3 and 4 are useful in showing the interrelation of the different tests. Table 3 shows a series of samples of refined tar made from the same raw tars. Table 4 on the other hand shows three tars of the same melting point made from three samples widely varying in free carbon.

TABLE 3.

| Sample No. | Free Carbon Percentages | Distillation Total to 315°C | Melting Point ° F | Schutte Penetrometer Sec. at ° F. | | Viscosity Engler 100cc. at 100° C. Sec. | Float Test at 500 C. Sec. |
|---|---|---|---|---|---|---|---|
| 5 | 12.1 | 21.8 | .... | 29 | 40 | 94 | 34 |
| 7 | 12.0 | 19.2 | .... | 108 | 40 | 127 | 38 |
| 8 | 14.0 | 16.4 | .... | 114 | 50 | 159 | 58 |
| 9 | 14.4 | 14.9 | 86.9 | 85 | 60 | 208 | 75 |
| 10 | 17.2 | 12.7 | 99.7 | 90 | 70 | 335 | 110 |
| 11 | 18.2 | 10.4 | 108.7 | 88 | 80 | 431 | 170 |

TABLE 4.

RELATION OF VICOSITY TO CARBON CONTENT.

| Sample No. | Free Carbon Percentages. | Melting Point ° F. | Schutte Penetrometer at 80° F. Sec. | Engler 100cc. at 212° F. Sec. | Float Test at 212° F. Sec. |
|---|---|---|---|---|---|
| 1 | 1.4 | 110 | 42.2 | 302 | 158 |
| 2 | 14.5 | 109 | 80.1 | 298 | 192 |
| 3 | 39.6 | 112 | 144.9 | 739 | 337 |

The pitches for filler work in stone block, wood block, and brick paving are now being standardized to correspond with the work done on refined tars for macadam road uses. In the last few years very good specifications have been drawn up from time to time. Perhaps the most recent are those offered by the city of New York, Borough of Manhattan, in the specifications published in 1914. The pitch for the stone block specification is as follows:

The coal tar paving cement shall be a straight run residue obtained from the distillation of coal tar and shall comply with the following requirements:

(a) Melting point shall be not lower than 110° F. nor higher than 125° F.

(b) Free carbon shall not be less than twenty per cent. nor more than thirty-five per cent.

(c) Specific gravity at 77° F. shall not be less than 1.22 nor more than 1.30.

(d) Specific gravity of the distillate to 670° F. shall not be less than 1.06 at 140° F., compared with water at the same temperature.

It is interesting to note that this specification is drawn up with the intent to use half sand and half pitch in the mixture to be poured between the blocks. This is in line with the most recent English practice and seems destined to prove a great advance in the use of pitch for filler purposes.

There seems to be no reason why this same formula may not be used with success in brick work, and serve to mitigate many of the annoying features of brick for use in residential streets. Experiments carried on this fall seem to point to a successful issue.

For wood block, the specification is slightly different due to the higher melting point desirable owing to the cutting back action of the creosote oil in the wood block and due to the fact that no sand is used with the pitch.

*Specifications for Wood Block Paving*:

The coal tar pitch shall be a straight run residue obtained from the distillation of coal tar and shall comply with the following requirements:

(a) Melting point shall be not lower than 135° F. nor higher than 150° F. The contractor before beginning work on any contract shall obtain from the Chief Engineer in writing a statement as to the melting point desired for that particular contract and a variation of 5° F., either way will be permitted from this melting point, which, however, must be within the limits, as indicated above.

(b) Free carbon shall not be less than twenty-two per cent., nor more than thirty-seven per cent.

(c) Specific gravity at 77° F. shall not be less than 1.24, nor more than 1.32.

(d) Specific gravity of the distillation to 670° F. shall not be less than 1.07 at 140° F. compared with water at the same temperature.

The specifications for road tars for use in the United States compared with similar specifications prepared for use abroad serve to accentuate the difference in practice.

In England, . . . tars for road purposes have reached a higher development than in other parts of Europe. Mr. Brodie's specification in Liverpool calls for a hard pitch which is cut back by the workman on the job with creosote oil until it has the proper consistency for the work. The remainder of the specification calls for doing the work in much the same way as the New York specification. Any specification such as that used by Mr. Brodie would certainly lead to disastrous results in our American cities and it seems far preferable to specify a material with a proper consistency already prepared for use. In reaching this consistency, however, the materials are made straight run, that is, that they are distilled to the proper point and are not made from harder pitches cut back with oils. This same comment can be made of the tars prepared for use as binders. In English practice, the English materials are cut back while the American materials are so-called straight run. It would seem that our American practice had much justification in obtaining successful work under American conditions. It would certainly add much to the difficulty of securing good work, if the consistency of the bituminous materials, as well as other variable conditions were left to the judgment of the foreman on the job. It was the practice that formerly obtained in New England tar concrete work and led to much bad work. It was only justifiable when done by expert workmen in an understanding manner.

The tars used for English surfacing work approach much more closely to American tars. It is difficult, however, to compare them directly through the obstacles thrown in the way of obtaining samples of English tars for comparison in the laboratory. A sample obtained by Major Crosby, of Baltimore, compared with the same American samples seemed to show superiority in some points of the English samples. Many of these points became eliminated, however, when the comparison was made with properly prepared standard American tars. The two materials under these conditions, seemed to show fairly close relation to each other. Few conclusions, however, can be drawn from the comparison of two samples and it would be desirable to compare a large number of samples used under different conditions. Certainly we have examples in this country, such as the Newton Boulevard, in the city of Newton, Massachusetts, which show that under proper road conditions, American tars can be depended upon to last as well, if not better, than the best English tars. The Newton Boulevard has now been in use for going on nine years with a single surface treatment of refined tar. The road bed, however, was most excellent and in prime condition for treatment. The treatment was most adequately put on, using a good tar and in the proper amount.

The American practice has had the advantage of English practice in that close study has been made in America of the pitches, while in England and on the continent, the study has been of the oils which have been utilized in the manufacture of various chemical products. The pitch in Europe has been a by-product with briquetting as the ultimate goal. The importance of the recovery of oils has led to the development of cut-back material often to the decided disadvantage of the materials.

# Sizes of Stone

By A. H. Hinkle, Deputy, Bureau of Maintenance and Repair, State Highway Department of Ohio

IN its relation to the macadam road, this is a subject of no little importance. It is usually discussed from two points of view, namely:

(1) The relation that the size of stone bears to the life or wearing value of the road.

(2) The relation that the size of stone bears to the economic question of stone production.

Naturally the first point of view is that usually assumed by the engineer, while the second is the one generally held in most prominence by the stone producer.

If we accept Wellington's definition of an engineer which is "An engineer is one who can do with one dollar what any bungler can do with two dollars," we must conclude that engineering is largely a question of economics and hence, a real engineer will not neglect to give due consideration to the economic question of the production of the material used in the works over which he has charge.

On the other hand, the future of the macadam road, and hence, the demand for stone, will depend upon the service the stone gives in the road. No one can doubt that a poor macadam road will have a favorable influence on the selection of other types of roads. So we are convinced without further argument, that the stone producer in fairness to his business, must be vitally interested in the subject of the wearing value of the stone in the road, which wearing value will depend upon the size and sizing of the stone.

Therefore, after a careful study of the subject, we must conclude that the engineer cannot neglect to consider the economic question of stone production and do justice to his profession, nor can the stone producer in fairness to himself neglect to consider the quality of stone he produces.



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Deputy, Bureau Maintenance and Repair

So we see at once that our question becomes a common one when looked at in the proper sense, and therefore can be discussed from the same point of view by both the engineer and the stone producer.

## METHOD OF SPECIFYING SIZES OF STONE.

In looking over numerous specifications for macadam roads, it will be observed that many methods of designating the size have been and are still being used. Many of these methods are almost meaningless because of the indefiniteness of the size they may represent. Some of the expressions, in use in specifications are the following:

Walnut size, hickory nut size, pea size.

1-inch stone, 2 ½-inch stone, etc.

No larger than a size that can be put in the mouth.

The size of the fist.

No greater than 1 ½-inch in their greater dimension, etc.

Notwithstanding the fact that these terms may not mean anything even approximately definite, so far as the size of the stone is concerned, these same specifications usually carry with them the "subject to the approval of the engineer" clause, and unfortunately for the stone producer every engineer under this proviso wants a different size of stone. This confusion and demand for such a large number of different sizes must embarrass the stone producer many times and add no little expense to the cost of production.

The most definite and at the same time practical method of designating the size of stone is to specify that it shall pass over a screen having holes of one size and through a screen having holes of another size. But even with this limitation an indefinite size is specified, for the size of stone will depend not only on the size of openings in the screens but also on the

(1) Shape of the opening.
(2) Angle of the screen.
(3) Speed at which the screen is turned.
(4) Rate at which stone is passed through the screen.
(5) Quality of the stone being crushed.
(6) Diameter of screen.

Usually but the first of these five additional qualifications is specified. It therefore behooves us to place some other limitation and I know of no better one than that in the Ohio State Highway Department's specifications which provides that the "materials shall be so graded in size that in no case, by laboratory test, will more than ten per cent. (10%) pass the smaller opening mentioned." This latter clause taken in combination with the size of openings in the screens makes a very definite specification, and a specification that is simple and easy for the stone producer to interpret, for he can soon determine once for all the variation in the last five factors mentioned above, which he can allow, and still comply with the specification. This method of designating the size of stone has been used this last year and I have learned of no objections to its use except in a few instances where the contractor has furnished too small a stone under the No. 23 size because of having removed the larger stone from this size, or the jaws of the crusher having been set too close, and was yet apparently complying with the specification. It seems necessary to place some limitation on this possibility.

## PROPER SIZE OF STONE TO USE IN THE SURFACE OF A WATER-BOUND MACADAM ROAD.

Proper size of stone to use in the surface of a water-bound macadam road, is a much discussed question. That the size and grading of the stone may largely determine the wearing value of the road, there can be no doubt. From the fact that the engineers who have given the subject much study disagree as to the proper size to use would lead one of conclude that there are many variable factors entering into the question of determining the proper size. Upon investigating, this is exactly what we find.

Older specifications in our own country invariably called for a relatively small stone in the road surface. A study of the history of the stone road shows the same thing prevailed in European practice. Tresaguet, the French engineer, specified stone the size of a walnut. John MacAdam, the English road engineer, specified the size of stone in various ways such as six ounces, size of hen's egg, or an inch in diameter. There were two reasons for using so small a stone in the road surface in early days which do not prevail at this time in a modern constructed water-bound macadam road. In the first place the stone were left for traffic to compact, the steam road roller not coming into use until about 1865, and not being extensively used for many years thereafter. Then, the traffic was mostly slow speed steel-tired traffic as compared with our present large proportion of high speed rubber-tired traffic.

A third reason which I surmise has some bearing on the use of larger stone in the road surface now than was used in former days, is the relatively greater proportion of horses now shod with long calked shoes.

In the light of the facts stated above, we can readily conclude that the use of larger stone in the road surface at present than that used in early days has come about through different existing conditions which associates the subject with our very

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progress of civilization and industrial development itself. But while we have many new conditions on our heavy traffic roads with which to deal at present which have influenced the size of stone used in the road surface, we still have on many of our secondary roads conditions similar to those of former days.

Let us discuss then briefly the following subjects with reference to their bearing on the size of stone that should be used in the surface of a road:

(1) Uniformity of product of the quarry.
(2) Thickness of strata from which crushed stone are made.
(3) Kinds of traffic.
(4) Methods of building the road.
(5) Hardness of stone.

Before discussing these five subjects, I am going to ask you to accept the truth of one statement which to me is one of the two greatest principles in road building: This principle is, that the wearing value of a road surface made of *any material* will vary with its uniformity (the more uniform the material, the more valuable will it be for a road surface). This is so evident that it would seem to need no proof. In the light of this axiom let us discuss the subject under the five headings mentioned above.

### (1). UNIFORMITY OF PRODUCT.

Stone from a quarry which has spots or layers of a much harder or much softer stone than the average output from the quarry are always less desirable than a uniform product. This objection is most prominently brought to our attention when a small field boulder becomes mingled with the broken limestone of the top course, or a piece of iron is left in the slag used in building the road. In only a year or so these foreign materials become quite prominent in the surface and are very annoying to traffic and they hasten the destruction of the road. While these extreme cases bring this subject prominently to our attention, yet a much less decided difference in the wearing value of two stones than that cited above will depreciate their worth as a road surfacing material when they are mingled together. If it is impractical to separate the two or more different qualities of stone from a quarry, then the next best thing is to produce the most intimate mixture that can be produced. This latter condition can be better accomplished by *crushing and screening the stone to a finer size.* There would then not so likely be present in the road surface a large piece of the harder stone surrounded by pieces of the softer stone.

### (2). THICKNESS OF STRATA FROM WHICH STONE ARE CRUSHED.

Thin layers of stone produce in the crushed product flat "slabby" pieces which are very objectionable to use in the surface of the road. By crushing the stone to a smaller size the crushed product will be more cubical in shape which is the desired shape of the road stone.

### (3). KIND OF TRAFFIC.

The kind of traffic has a rather peculiar bearing on the size of stone that should be used in the surface. The objection that first appears to the using of large stone in the surface is that the road becomes rough. A relatively large proportion of *heavy* steel tire traffic will wear off the large stones and aid in keeping a road smooth, while, with a light horse drawn traffic combined with a heavy auto traffic the road may become very rough. On the other hand the heavy auto traffic will usually sooner or later demand a bituminous surface of some kind in which case the road surface made of quite large stone are more esaily cleaned and prepared for such a treatment. We would then conclude that a road surface which did not bear a relatively large amount of heavy steel tire traffic and which it was *intended to maintain as a waterbound macadam,* should not be made of as large stone as might be used in some other cases.

### (4). THE METHOD OF BUILDING.

It is hardly necessary to state that a larger stone can be used in the surface of a road built in accordance with our modern waterbound macadam specifications where a roller is used, than in building a loose stone road. The successful use of quite large stone under the former condition has misled many people to attempt to surface a road with loose stone of the large size. This has provoked no end of criticism because of the serious handicap to traffic offered by loose stone of large size.

### (5). HARDNESS OF THE STONE.

It is generally conceded that a soft stone, because of being more easily crushed under the roller should be crushed to a larger size than a hard stone.

With all these variable factors effecting our question we need not wonder that engineers as well as road users and the manufacturers of stone have varied and different opinions as to the proper size of stone to use. (And let me say right here, that if the stone producer were accustomed to paying as much attention to the tests on, and variations in, his product as the brick manufacturer is wont to do, there would be more known about the relative value of different qualities and sizes of stone from any plant).

Now before we comment briefly upon more specific sizes to use for various purposes, for convenience, let us designate these sizes by number.

The State Highway Department and your Association have agreed on a common set of numbers to designate specific sizes of stone. This is a great convenience in preventing contractors from becoming confused and ordering the wrong size of stone. (No little credit is due your own secretary in bringing about this harmonious agreement on a common designation for the same size). This set of numbers which is the designation of the sizes of stone in the State Highway Department's specifications is as follows:

### SIZE OF AGGREGATE.

The various sizes of mineral aggregates of all grades, separated by screens having circular openings of the diameters specified, will be designated throughout these specifications by the following system of numbers:

No. 1.—Material passing through a 4 inch and retained on a 2½ inch opening. No. 1 size for stone with an abrasion loss of less than six per cent. (6%), shall consist of material passing through a 3½ inch and retained on a 2 inch opening.

No. 2.—Material passing through a 2½ inch and retained on a 1½ inch opening.

No. 3.—Material passing through a 1½ inch and retained on a ¾ inch opening.

No. 4.—Grit. Material passing through a ¾ inch and retained on a ¼ inch opening.

No. 5.—Screenings. Material passing through a ¾ inch opening and containing not more than eighty per cent. (80%) nor less than forty per cent. (40%) of material that will be retained on a ¼ inch opening or square mesh.

No. 6.—Grit. Material passing through a ½ inch opening and retained on a 3-16 inch opening or square mesh.

No. 7.—Screenings. Material passing through a ¼ inch opening or square mesh and containing not more than thirty per cent. (30%) of material that will pass a number one hundred sieve.

No. 23.—Material passing through a 2½ inch and retained on a ¾ inch opening.

All the above materials shall be so graded in size that in no case, by laboratory test, will more than ten per cent. (10%) pass the smaller opening mentioned.

No. 34.—Material passing through a 1½ inch opening and by laboratory test containing not more than five per cent (5%) of material that will pass a ¼ inch opening and not more than seventy-five per cent. (75%) of material that will pass or be retained on a ¾ inch opening.

The size designated as No. 1, it will be noted, is to pass a 3½ inch circular opening when the abrasion loss is less than 6%, and a 4 inch circular opening when the abrasion is over 6%. This is the size used in the surface of our waterbound macadam roads. I believe that the maximum size for the best results had been exceeded when the largest size that would pass a 4-inch circular opening was used for all grades of stone. I think it very possible that it will be found that the 3½ inch should be the largest ring used for all sizes. However, inasmuch as many of the roads built by the State Highway Department will receive a heavy automobile traffic which perhaps will warrant the application of some form of surface treatment in the future, a slightly over size stone may not be seriously objectionable. If I were to select the size of stone to be used

in the surface of a waterbound macadam road, that I knew was to remain as a waterbound macadam road until worn out, I should prefer even a smaller size than would pass a 3½ inch ring, perhaps the number 2 size here specified if it could be secured in sufficient quantities.

However, there is much merit in the large stone in the surface, and we should not fluctuate from the extremes of exceedingly large stone to too small stone, but adopt a medium size which are known to give good results for the purpose they are intended. The roughness of a waterbound macadam road which has resulted only from too large stone can be very materially reduced by the addition, preferably during a wet period or the wet season of the year, of additional screenings and then rolling. The principal objection to this method of maintenance is that the surface becomes quite dusty during a dry period. This can be reduced somewhat, however, by the use of screened screenings, or screenings from which the dust has been removed. The rolling and traffic will grind up the small particles of stone sufficiently fast to supply binder for the macadam surface.

Perhaps here will be the most appropriate place to say a few words about the size of screenings most suitable for binding a waterbound macadam in its original construction. Some engineers prefer screenings all of which will pass a ¼ inch opening, while the extreme on the other hand was observed this last summer, when one of the best waterbound macadam road engineers in the State stated that he could build the most durable road with the use of screenings from which the dust had been eliminated. While this latter is perhaps true, it is doubtful if the additional cost of extra rolling and the screened screenings would be compensated for. It is believed that the No. 5 screenings are the most practical to use, except with slag and the very hardest limestones where the No. 7 screenings may have to be used to get a bond in the macadam with a reasonable amount of rolling. It certainly is a blunder to use screenings which are largely dust of the softer limestones, to bind the coarse stone. This excess of powdered limestone is the source of no small amount of trouble, one of the chief objections being that it forms a sticky paste when mixed with water which will stick to the wheels of vehicles and be plucked from the surface either leaving the stone exposed to ravel or perhaps disturb their position in the road. This is most noticeable during the first thaw after the road is constructed. No small amount of the waterbound macadam roads are injured by this process.

It would seem that it would not be out of place to lay down the general principle that the largest size stone should be used in the surface that will not be objectionable because of roughness of the surface produced.

The sizes of stone called for must *take into consideration* the entire output of the quarry. By allowing an option on No. 1, 2, or 23 size to be used in the base course and specifying No. 5 screenings for filler, it would seem that the present specifications of the department have provided for this as well as can be done economically.

FROM THE PRECEDING DISCUSSIONS WE MAY DRAW THE FOLLOWING CONCLUSIONS:

(1). That while the engineer is usually interested more directly in the quality of stone used in the road, and the stone producer is usually interested more directly in the cost of production, yet the former if he fulfills the broader definition of an engineer, must be concerned in the economic production of stone, and the stone producer as a matter of self interest must be vitally interested in the quality of stone produced.

(2). The method of specifying the size of stone should be fairly definite in order to prevent confusion of sizes and to lessen the possibility of having stone rejected after it has been shipped and thus entailing a loss to the stone producer as well as a loss to the contractor due to delays in deliveries.

(3). The size of stone coming from any screen will depend upon not only the (1) size of opening, but also on

(2) The shape of opening;

(3) The angle of the screen;

(4) Speed at which the screen is turned;

(5) Rate at which the stone are passed through the screen; and

(6) The diameter of the screen.

(4). Older specifications invariably called for a quite small stone in the surface of the road, and no doubt justly so, for the method of building roads without a roller and the traffic conditions in former days were such as to forbid the use of as large stone as are now used.

(5). There are places where the conditions are very similiar to those of former days in which case we should still use small stone in the surface.

(6). The following things affect the size of the stone that should be used:

(1) The uniformity of the product of the quarry;

(2) The thickness of the strata from which the crushed stone are made;

(3) Kind of traffic;

(4) Method to be used in building the road;

(5) Hardness of the stone.

(6-1). When made from a uniform outcrop, a larger stone can be used than when made from a non-uniform product.

(6-2). Crushed stone made from thin strata of rock should be reduced in size sufficient to produce a stone of a cubical shape.

(6-3). Larger stone can be used in the surface of a road that it is intended to surface with bituminous material later on, than in a surface which it is expected will remain as a waterbound macadam.

(6-4). A road surface built with the aid of a roller will permit the use of larger stone than should be used in a loose stone road.

(6-5). The harder the stone the smaller should be the crushed product used in the surface.

(7). It is believed that a 3½ inch circular opening will furnish the largest size stone that should be used in the surface of a road under most any condition.

(8). That perhaps for a road surface that is *to remain a waterbound macadam,* No. 2 size stone of the harder limestone will be a more satisfactory size in the surface.

(9). There is much merit to the large stone in the surface and hence the product of different products, from any quarry should be studied and the largest size used that will not be objectionable because of the roughness of the surface which is produced.

(10). That a more durable road of the softer limestone may result by using screened screenings instead of screenings with the dust in, as a filler, but it would not likely be practical to do so; the No. 5 screenings are the most desirable to use as a filler except with the very hardest limestone and slag where the No. 7 screenings should be used.

(11). That the careful screening and sizing of the stone for the purpose of producing a *uniform product* is usually of vastly more importance than a minute differentiation purely for the purpose of getting a specific size of stone.

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## Essential Physical Properties of Sand, Gravel, Slag and Broken Stone for Use in Bituminous Pavements

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IN discussing the various physical properties of mineral aggregates it must be borne in mind that it is impossible to fix universally applicable definite values for them as these will vary with the type of pavement and the kind and density of the traffic to which it is subjected. In order to understand fully the extent to which these considerations affect the selection of the mineral aggregate to be employed and modify any standards set for their essential physical properties, it is necessary to have clearly in mind the different types of bituminous pavement and of traffic and to discuss briefly a few points illustrative of their mutual relationship.

The types of pavement considered in this connection are:

1. Sheet Asphalt, Binder Surface,
2. Bituminous Concrete,
3. Bituminous Macadam,
4. Asphalt Block.

Lecture in the Graduate Course in Highway Engineering at Columbia University, delivered on January 26, 1916.

5. Oiled Macadam,
6. Gravel.

Broken stone or gravel is used in all of these types but in the case of sheet asphalt their use is restricted to the binder course in which they are not directly subjected to wear. In all the other types the broken stone or gravel forms part of the wearing surface. Obviously in the binder course neither of them would be required to possess the same degree of wear resisting quality as when used in surface.

The kind of traffic may be classified as: Iron tired, chiefly horse drawn; rubber tired, chiefly self propelled; mixed, both horse drawn and self propelled, and without entering into a detailed segregation, the traffic itself may be classified as: Light, medium, heavy.

Stone and gravel which would crush under heavily loaded iron tired traffic would carry the same weight without fracture if rubber tires were used. The same distinction would apply in the case of heavy traffic as compared with light traffic.

A certain amount of crushing, thus increasing the proportion of fine material in the mineral aggregate, is desirable in certain types of pavement, such as tarred slag, when sufficient quantities of a soft bituminous binder are used with it which will readily coat the freshly fractured surfaces at ordinary atmospheric temperatures.

Where the bitumen is present in insufficient quantity or where it requires temperatures higher than atmospheric ones to make it adhere satisfactorily to the particles, the reverse is true.

Having before us this very wide range of conditions which must be met, we next come to a consideration of the physical properties themselves which are ordinarily regarded as essential. These are: Shape, character of surface, wear resisting quality, size, cleanliness.

### SIZE.

Owing to the fact that all bituminous cements soften materially under heat and therefore lack stability in hot weather, it is desirable and necessary to obtain as great a degree of stability as possible in the mineral aggregate. This of course requires angularity in the particles whether they be coarse or fine; gravel with its rounded particles has much less stability than broken stone. For this reason it is often passed through the crusher before using it. Stone which is crushed so that the particles are chiefly cubical in shape is to be preferred to stone that is crushed so that slivers predominate. These slivers do not compress as easily as do cubical particles to form a compact mass with a minimum of voids and are much more liable to fracture under the stress and weight of traffic. When the particles are small, their lack of weight and sizes render them more subject to displacement and angularity and consequent interlocking of the particle is very essential. At first sight this would appear to be much more important in the case of sand than in the case of stone. The larger the particle, however, the greater the leverage with which it may act under a force tending to displacement, hence there is not so great a difference between the relative importance of angularity in sand and stone. In fact, in certain cases it is more important with stone than with sand. In the binder course in sheet asphalt pavements, which is intended to increase the stability of the sand wearing surface and key it to the concrete and retard its movement upon the surface of the concrete, sharpness of stone is essential. For this reason gravel makes a very inferior binder and should not be used where it is possible to obtain stone. When used, it should be cracked by passing it through a crusher. Not only do rounded particles move on each other with greater ease than angular, but in masses they have fewer points of contact.

### CHARACTER OF SURFACE.

As our consideration of the materials under discussion is limited to their employment in bituminous pavements, it is necessary for us to consider the surfaces of them chiefly in connection with their ability to receive and retain a coating of sufficient thickness of the bituminous cementing material. Certain types of surfaces are much more desirable from this standpoint than are others. Broadly speaking, a rough, pitted and somewhat absorbent surface is the best. Smooth glossy surfaces do not readily retain a thick coating of bitumen and require a relatively high heat to insure properly coating them. At a high heat the bitumen becomes very liquid and readily runs off of them, which results in a coating of undesirable thinness. Even when the temperature at which they are coated is no higher than that employed with rough surfaces, their smoothness permits the bitumen to drain off more readily. This is particularly the case with flint particles and sands containing them, when coated with bitumen and examined under a glass invariably show the minimum thickness of coating on the flint particles sharply contrasting with the surrounding rougher surfaced quartz particles which have retained a coating of normal thickness. As compared with a non-absorbent surface, an absorbent one perse is to be desired. Unfortunately most particles which have absorbent surfaces are lacking in resistance to wear and therefore, notwithstanding their superiority from the standpoint of coating them with bitumen, are not suitable for heavy traffic more especially of the iron tired variety. Where the bituminous cement used is lacking in cementing value an absorbent surface is especially necessary.

The speaker knows of a number of roads in which distinctly inferior bituminous cement was used which gave excellent satisfaction under medium and light traffic due to the fact that the mineral aggregate was a porous limestone. The same bituminous cement with hard non-absorbent rock failed utterly when used in similar types of construction on roads carrying an equivalent traffic.

The outer surface of the particles must be firmly adherent to and form a permanent part of the particles themselves and must show no tendency to scale off when heated. Certain sands upon heating appear to form loosely adherent scales upon the surface of their particles which are not removed by attrition in the mixer but which under the stress of traffic and atmospheric changes in temperature become loose and detach themselves, carrying the coating of bitumen with them. Pavements laid with this type of sand have been known to disintegrate from this cause alone within a few weeks from the time they were laid. Gravel, freshly broken slag, and stone are ordinarily free from this defect. Slag which is glassy does not coat as well with bitumen as do the more basic slags.

### WEAR RESISTING QUALITY.

This, while a very important property, is perhaps more of a variable one than any of the other qualities mentioned. The degree required depends upon the kind and density of the traffic, the size of the particles, the type of pavement and the hardness of the wearing surface considered as a whole. We have already noted that an iron tired traffic exerts a greater crushing action than a traffic that is carried on rubber tires and it goes without saying that a dense traffic is more severe in this respect than a light traffic. Up to a certain point, the larger the particle, the greater the liability to fracture and where the traffic is very heavy, aggregates consisting of relatively large particles will not give satisfactory service even though composed of the hardest known rocks, unless the particles are sufficiently massive to resist fracture, as for instance ordinary paving sets, which are of course outside the limit of bituminous pavements. In other words, broken stone or gravel of from ½ to 1½ inches in size requires more careful scrutiny as to its resistence to fracture than do sand or paving blocks. Resistance to fracture is of course only one of the elements going to make up wear resisting quality. Hardness is also a requisite, although a very hard and at the the same time brittle material would not be suitable for use in bituminous pavements. A pavement which is soft and yielding as a mass does not require as hard and tough a mineral aggregate as does a more unyielding pavement. The shock or impact, as well as the grinding action of traffic, is minimized by the plasticity of the pavement in the same way that it is difficult to break a rock of relatively small size when supported on a yielding bed. When the particles are heavily coated with a relatively fluid bitumen, fractures of the particles are to a certain extent self healing. In this type of pavement, therefore, somewhat softer rock may be safely used than in those types in which the bitumen is harder and the coating on the particles thinner.

### SIZE.

This property has to do not only with the actual size of any one particle or set of particles but also embraces the question of the relative size of the different particles composing the aggregate as a whole, which constitutes what is frequently re-

ferred to as the grading of the mass. As previously mentioned, large sized aggregates will not carry excessively heavy traffic and this not only refers to the difference between broken stone and sand but to different varieties of sand as well. For ordinarily dense and heavy traffic, sheet asphalt pavements carry from 2 to 10 per cent. of sand particles which will just pass a 10 mesh sieve and are approximately 0.027 of an inch in diameter. Where the traffic is exceptionally heavy, particles of this size are liable to fracture and the maximum size must be still further reduced. In certain heavily travelled streets in Glasgow, Scotland, the speaker was forced to limit the maximum size of the sand particles to those which would pass a 30 mesh seive. Such particles would have a diameter of approximately 0.01375 of an inch. The ability of a very fine and comparatively soft aggregate to sustain the heaviest known traffic is perhaps best exemplified by the French rock asphalt pavements. These pavements are largely composed of particles which will pass a 200 mesh sieve and have an approximate diameter of 0.00235 of an inch. The particles themselves are composed of a soft limestone thus showing the possibility of using relatively soft materials when they are in a fine state of division. The bitumen with which they are coated is relatively quite soft which again accentuates a point previously referred to; namely, the possibility of using soft materials with a fluid bitumen. The relative size of the different particles or the grading of the mineral aggregate is perhaps one of the most important considerations in the construction of a bituminous pavement. On it much of the success of the pavement depends. The maximum size of the particles and the allowable proportion of maximum sized particles is, as we have seen, dependent upon the traffic. If all the particles were of practically the same size, they would touch at only a few points of contact and the pavement would have a large percentage of relatively large voids. The weakness of the bond due to the few points of contact would make it pick up or ravel under traffic and the relatively large sized voids would permit the bitumen to drain off the hot aggregate during transit to the street or road leaving a very thin coating on the particles and thus still further weakening the bond. Any considerable excess of bitumen in the mixture would result in the formation of "fat spots" in the pavement where the excess of bitumen had collected. If the temperature at which the mixing took place was lowered, there would be danger of not properly coating the particles and in cold weather a mixture of this type would be very difficult to rake and would break up under the roller and it would be impossible to compress it into a compact mass. It is therefore essential to fill up these large sized voids with smaller particles. If all these small particles were exceedingly minute, they would present a very large surface area to be covered by bitumen and would therefore increase the cost of the pavement. The mass formed by them would be very plastic owing to the relatively high percentage of bitumen necessitated by the conditions of mixing and would not key the larger particles together as firmly as if the filling mass were partly composed of the largest sized particles which would go into the voids between the large aggregate. The French rock asphalt while composed almost entirely of very small particles has a very high degree of stability and contains a relatively low percentage of bitumen by which it has been impregnated by natural processes in which time was not a factor. The average time of mixing a batch of bituminous pavement does not exceed one minute and the consistency of the bitumen is usually much harder than that found in the French rock. It is therefore impossible under working conditions to satisfactorily coat a fine aggregate with as small a percentage of bitumen as is found in the French rock and the stability of the mixture is lessened by this relative excess of bitumen. It is therefore essential to first fill the voids between the maximum sized particles with the largest sized pieces that will go in them. The remaining voids should then be similarly filled and so on down to those voids which can only be filled by particles passing a 200 mesh seive. The proportion of these particles will not ordinarily exceed 15 per cent. in a sheet asphalt pavement, the governing factor being the production of a dense surface which will not be water absorbent and having as large a proportion of mineral aggregate as possible. Closeness of grain could, of course, be obtained by an excess of bitumen but this would increase expense and reduce stability. Where the maximum size of the particles approaches one inch the percentage of 200 mesh material in the pavement is of course much lower than in sheet asphalt pavements and varies from 3 to 5 per cent. on the average. Particles of 200 mesh sand are not desirable in a pavement owing to the fact that they detract from its stability and if present to any considerable extent tend to make the mixture mushy. All of the greater portion of the 200 mesh material should be finely ground limestone or Portland cement as this materially adds to the stability of the pavement.

In order to comprehend how the increase in fine material adds to the surface area to be covered with bitumen let us consider a one inch cube of stone. It has six sides each one square inch in area or a total of six square inches. Let us now saw it through the middle. It has now the original six sides and two more, each of one square inch in area or eight square inches in all. Keeping the pieces together and cutting it again in a plane at right angles to the first cut we add two more square inches in surface area, making 10 square inches in all, although the volume of the mass has not been increased.

In certain of the tarred slag pavements in which a very soft tar is used, the pavement as laid is very deficient in fine particles. The top layers of slag are expected and do crush to a very considerable extent under traffic and the fine particles thus produced are coated by the soft tar at atmospheric temperatures and are incorporated into the pavement, thus, in a short time forming a dense compact mass which under light and medium traffic gives excellent satisfaction. A large quantity of this pavement is laid on country or surburban roads in England and costs about half a crown (62½ cents) per square yard. With any other type of bitumen which was not very fluid and which would not coat particles satisfactorily at atmospheric temperature, such a pavement would be a very dangerous type to lay. The sharp particles of slag key very firmly together and once the sufficient amount of fine material is produced by traffic crushing, the pavement is a remarkably stable one and sufficiently close grained to keep the water out. As illustrating the grading in various kinds of pavement, the following typical examples are given:

| | Sheet Asphalt | | | Bituminous Concrete | |
|---|---|---|---|---|---|
| | Heavy Traffic | Light Traffic | Topeka | Hot Mixture | Cold Mixture |
| Bitumen | 11.0% | 10.5% | 8.5% | 7.0% | 6.5% |
| Passing 200 mesh | 14.0% | 10.5% | 8.5% | 5.0% | 4.5% |
| Passing 100 mesh | 14.0% | 10.0% | 6.0% | 4.0% | 1.5% |
| Passing 80 mesh | 13.0% | 10.0% | 6.0% | 2.0% | 1.5% |
| Passing 50 mesh | 19.0% | 14.0% | 6.0% | 5.0% | 1.5% |
| Passing 40 mesh | 11.0% | 14.0% | 10.0% | 4.0% | 1.5% |
| Passing 30 mesh | 10.0% | 13.0% | 10.0% | 4.0% | 1.5% |
| Passing 20 mesh | 5.0% | 10.0% | 9.0% | 3.0% | 3.0% |
| Passing 10 mesh | 3.0% | 8.0% | 6.0% | 5.0% | 5.5% |
| Passing 8 mesh | ..... | ..... | 6.0% | 3.0% | 5.0% |
| Passing 4 mesh | ..... | ..... | 14.0% | 7.0% | 8.0% |
| Passing 2 mesh | ..... | ..... | 10.0% | 20.0% | 40.0% |
| Passing ¾ mesh | ..... | ..... | ..... | 14.0% | 11.0% |
| Passing 1¾ mesh | ..... | ..... | ..... | 12.0% | 9.0% |
| Passing 1½ mesh | ..... | ..... | ..... | 5.0% | ..... |
| | 100% | 100% | 100% | 100% | 1 00% |

In addition to the increase in stability due to the proper grading or sizing of the different articles and the consequent increase in density, a reduction in the size of the voids is obtained. The latter feature is essential in that it keeps the water out of the pavement. Any bituminous pavement which is sufficiently porus to permit the water to enter it and be retained therein will soon disintegrate due to the loosening of the bond between the bitumen and the particles by the action of the water. Another consideration involved in the selection of the size of the mineral aggregate is the kind of surface desired on the finished pavement. The larger the aggregate the rougher and less slippery the surface. We have already seen, however, that with a very heavy traffic, large sized aggregates are not permissible. A smooth fine grained pavement composed of small particles, if properly designed, is suitable for all kinds of traffic but is undoubtedly more slippery than the coarser type.

### CLEANLINESS.

Many sands and gravels have finely divided clayey material adhering to their larger particles. Such sands and gravels are unsuitable for use in bituminous pavements. When passed

through the heating drum or dryer, this clayey deposit becomes burned on to the surface of the grains by the heat to which it is subjected to such an extent that it is not removed by attrition in the mixer. It thus prevents the bitumen from coming into contact with the actual and permanent surface of the larger grains and subsequently breaks loose from them carrying the bitumen with it. This results in the disintegration of the pavement as the uncoated particles soon wear or wash away leaving depressions in which water will accumulate. Clayey material, unless finely pulverized after drying, is always objectionable. Even if it does not adhere to the grains, it bakes into balls in the dryer, only the outside of which can be coated with bitumen and these balls readily break up under traffic leaving similar depressions to those above described. A pat of surface mixture made of clayey sand will, when broken open, invariably show these balls with uncoated powdery centers. In a recent type of bituminous pavement the manufacturing process involves the pulverization of the mineral aggregate after it has been dried and heated. Under such conditions clay makes a most excellent paving material as it readily absorbs the asphalt and clings tenaciously to it, the bond between them being much stronger than in the case of sand, gravel, or crushed rock. Under certain special conditions, therefore, that which is ordinarily to be avoided becomes highly desirable. Crushed stone or gravel from which the dust has not been removed and which has been allowed to stand exposed to the weather will almost invariably have the larger particles partly covered with strongly adherent stone dust which has formed a sort of cement by the action of water, and material of this kind should be rejected. For this reason, most specifications call for freshly crushed stone. This is especially important in the case of stone for use in asphalt blocks. The bituminous cement largely used in the manufacture of these blocks has a high melting point and is therefore not very fluid at the temperature employed during mixing. Under such conditions the use of a clean stone is absolutely essential. A very fluid bitumen might perhaps be sufficiently absorbed by these fine particles to permit of its reaching the actual surface of the stone through capillary action during the mixing process and might even be relied on to subsequently coat the large particles at atmospheric temperatures after their imperfectly adhering mineral coating had become detached in the pavement by the stress of traffic. With a bitumen of high melting point and low ductility this would, however, never take place.

At first sight it might appear that the addition of 5 to 20 per cent. of finely ground Portland cement or lime dust to the mixture would produce the very conditions of finely divided particles adhering to the larger ones that has just been classified as extremely undesirable. It must be remembered, however, that this filler is added to the mixture after it has passed through the heating drums and is in itself dry and there is therefore no chance of its becoming baked on or firmly attached to the larger particles.

In the practice of his profession the engineer is frequently confronted with the problem of selecting not that which is economically the best in the long run but what is the best that can be done with the appropriation that has been put at his disposal and the speaker hopes that the foregoing discussion will in some degree aid him in this most difficult task. If the sand is unsuitable or very expensive to obtain and the traffic is not very heavy and a satisfactory supply of rock at a reasonable price is at hand, rock is obviously the material to use. If the rock is unsuitable or dear and the sand good and cheap, a sand asphalt mixture will carry practically every kind of traffic. With a cheap local supply of bitumen of fair but somewhat inferior quality, an absorbent limestone will often make a very satisfactory pavement for carrying light traffic. Sands which are lacking in fine or coarse particles can frequently be brought up to the proper standard of grading by the addition of fine or coarse unweathered crusher screenings.

SUMMARY.

Sand should be clear grained, hard and moderately sharp. The grains should be chiefly quartz and should have rough pitted surfaces. If necessary, as will usually be the case, the proper mesh composition or grading must be obtained by the mixing of several sands or possibly by the addition of unweathered crusher screenings. In the ordinary type of sheet asphalt pavement the presence of clay is undesirable, either as a coating to the grains or disseminated throughout the mass. For medium and heavy traffic pavements all particles retained on a 10 mesh screen should be discarded. For light traffic three to five per cent. of 8 mesh particles can be incorporated in the pavement with advantage. Sands containing a large percentage of flinty grains should be avoided.

Gravel should be clean grained, hard and free from adhering clayey particles. It is lacking in stability owing to the roundness of its particles and is usually considerably improved by passing it through a crusher. Gravel with a rough pitted surface is to be preferred and gravel containing a large percentage of flinty particles is to be avoided. Unsuitable for the construction of pavements carrying heavy traffic and inferior in all respects to crushed stone.

Slag. *Hard,* dense, basic slag is to be preferred. Should be stable when exposed to weather and not show any tendency to slack or disintegrate. Only suitable for light traffic and should preferably be coated with a very fluid bitumen.

Broken Stone. Should be freshly crushed, preferably in cubical shaped particles. Size and hardness required depends upon the traffic which the pavement is to carry. Dense hard limestone will carry medium and light traffic satisfactorily. When the traffic, though light in volume, is composed of heavy iron tired units, a dense hard trap is required. Trap is now commonly used for asphalt block manufacture, although in the past a large number of asphalt blocks made from limestone gave excellent service under light traffic. Granite is not usually satisfactory as it is too coarse and uneven in texture and much of it is friable and it is liable to shatter in crushing. Mesh composition just as important as with sand. Not suitable for use in pavements carrying very heavy traffic.

* * *

## Annual Meeting of the American Society of Civil Engineers

THE annual meeting of the American Society of Civil Engineers was held at the Society House on West Fifty-Seventh Street, New York City, January 19th to the 21st, both inclusive, and was just as interesting and important as are always the annual meetings of this, the largest and most powerful civil engineering society in the world. The attendance was, as usual, large, more than seven hundred members having registered at the one business session which was held. As is usually the custom, the balance of the time on the days assigned for the meetings was devoted to instructive inspection trips, the annual dinner and dance and the business session of the Special Committee on Materials for Road Construction and on Standards for their Test and Use. The first installment of this most important report will be found on other pages of this issue, and the balance will be published in the April issue of Better Roads and Streets, in accordance with the custom established three years ago.

The annual report of the Board of Direction showed that the Society is in the usual flourishing condition, with a membership at the beginning of this year of 7,909, and with enough new members admitted during the period up to the annual meeting to bring the total membership above the 8,000 mark. The finances of the Society were likewise shown to be in excellent condition, the assets being about $660,000, and the usual installment of $10,000 having been paid off during 1915.

After the annual prize awards were made, the following officers were elected to serve until the next annual meeting next January in New York City.

President, E. L. Corthell, New York City; Vice Presidents, Alfred Craven, New York City; Palmer C. Ricketts, Troy, N. Y.; Treasurer, Lincoln Bush, New York City; Directors. V. G. Bogue, New York City; Alexander C. Humphreys, New York City; O. F. Clapp, Providence, R. I.; R. Khuen, Pittsburgh, Pa.; F. G. Jonah, St. Louis, Mo.; E. Duryea, Jr., San Francisco, Cal.; Secretary, Charles Warren Hunt, New York City.

It was then unanimously decided to hold the annual convention of the Society at Pittsburgh, Pennsylvania, the latter part of next June, the date to be decided upon later.

The Society has a number of important special committees, and all of these committees made special reports at the business session, most of these reports being progress reports.

Two road and pavement sessions were held on January 21, following and in connection with the annual meeting of the Society. At these sessions, the Report of the Special Committee on Materials for Road Construction and on Standards for their Test and Use was presented. This report included a semi-final report with appendices on non-bituminous road materials, and was one of the most interesting reports presented at the session. This report and the discussion thereof consumed far more time than did all of the other reports combined, and several hundred of the best known road and street officials in this country were in attendance at these sessions. The report in full will be found on another page of this issue of Better Roads and Streets, together with a portion of Appendix B. It is only during the past year that this committee has had the non-bituminous portion of its title, and it was the intention of the committee to report only on that portion of the subject this year, the report last year having covered, as a progress report, bituminous materials.

In discussing the Committee's report this year, Eugene W. Stern, Chief of the Bureau of Highways, Borough of Manhattan, New York City, presented a motion recommending to the Board of Direction of the Society that the Committee be enlarged from its present number of seven members to a committee composed of fifteen members. Leonard Metcalf, of Boston, Massachusetts, offered as an amendment to this motion the recommendation that the scope of the Committee be so enlarged that it would cover and include all road materials and all road work. There was considerable discussion over this motion and its amendment, in which discussion Major W. W. Crosby, Chairman of the Committee also took part. Some of the members contended that the road committee had evidently limited its activities and that it had not presented as complete a report and discussion of the road question as would naturally be expected after the number of years at which it has been at work. In answer to this contention, the Chairman stated that the activities of the committee were definitely and positively limited by its title, following which the amended motion was adopted by the meeting. It was also explained by Major Crosby that the work of the committee of which he is chairman is limited to materials, and that the consideration of construction materials is excluded for this reason.

The opening of the discussion following the presentation of the report was devoted to broken stone, slag, and gravel roadways. A lengthy written discussion was presented by E. P. Green, a well-known engineer of Chicago, in which discussion he claimed that if clay is good as a void filler in a gravel roadway surface, it should also be equally good in a water-bound macadam roadway surface. This statement is in direct disagreement with the conclusions in the report of the committee. Mr. Green also said that if the drainage and maintenance of a road are adequate, the troubles from frost action will be reduced to a minimum, and that gravel as a road building material is not properly appreciated by many engineers.

James H. MacDonald in discussion stated that clean sand used in conjunction with limestone dust is a good and useful void filler for roads of the bituminous macadam type, but that sand should never be used as a void filler in the construction of a water-bound macadam road owing to the fact that it acts as a wedge. Mr. MacDonald brought this point up in view of the fact that the report of the committee contained the following statements: "For water-bound roadways of some limestones or of some slags, it will be advisable wherever practicable to use for one-half of the void filler a non-cementitious material, such as clean sand, with the other half of the finer particles of the material itself."

T. J. McGovern, a well-known road contractor of Trenton, New Jersey, cited the case of a gravel road which he had built some years ago in Mercer County, New Jersey, where he had used mud, sand, clay, and gravel as a binder, all with about equal success. This road, he stated, had not been rolled, and although portions of it are now ten years old, they are still in excellent condition. The use of the roller, he stated, is not always necessary, and he offered to take any engineers present over roads which he had built where a roller had and had not been used, and stated that they would not be able to pick out these which had been rolled from those which had not been rolled. At this point, James H. MacDonald asked whether the gravel had been spread across the road or whether it had been spread longitudinally with the axis, stating that if it was spread across the road the surface would ravel, while if it was spread longitudinally the road would be bonded. Naturally, this created somewhat of a surprise.

Mr. MacDonald also stated that he had found by many years of experience that if the material used is graded approximately eighty per cent. metal and twenty per cent. binder the best results will be obtained, and that the road should be built in layers, decreasing the size of the crushed stone or gravel as each course is laid, until the size is reduced to one inch in the top course.

A. N. Johnson, formerly State Highway Engineer of Illinois, and now consulting engineer of the Association of American Portland Cement Manufacturers advocated the use of unscreened stone so far as the sizes from one to two and one-half inches are concerned, and then harrowing with a stiff-tooth harrow. This, he stated, brings the large stone to the top and permits the small stone to drop down in the road. Harrowing the stone four times will aid materially in compacting the material, and as a road is built in this manner, only about one-half as much rolling will be required. Robert A. Meeker, State Highway Engineer of New Jersey stated that he favored the construction of roads of this type in several courses, but that he favored the use of screened materials.

It was also brought out in discussion that the shipments of different sized stone do not come in regularly and just as and at the time they are wanted, that often delay is caused by a shortage of stone of just the size that is wanted, and that stone from different quarries and also from the same quarry does not run uniform and even in size, as very often when a quarry is rushed, proper grading and screening is neglected and stone that is shipped as one and one-half inch stone is really three-quarter inch stone.

Portland cement concrete pavements was the next subject taken up, the discussion being opened by K. H. Talbot of the Universal Portland Cement Company, Pittsburgh. In opening, Mr. Talbot stated that he advocated definite rather than general statements by all committees, and particularly by one of such importance as this one. He also advocated the use of the term "pavement" instead of "crust" as used by this committee. He then explained the proper preparation of the sub-grade for cement concrete pavements, this being a most important matter, as when the sub-grade is not of the proper and uniform compactness it should be torn up immediately and well rolled until it is uniformly compact. Clays can be rolled too much, as moisture is certain to enter the clay, whereupon it will expand and the result will invariably be injurious to the completed roadway surface. It was also brought out that the tendency in the past was, and still is, in fact, to use too wet a mixture of concrete. The cement concrete road, Mr. Talbot stated, is nothing more or less than a macadam road bound with Portland cement, the stone being bound together with a mortar of sand and cement, and this mortar should, therefore be of high strength, and much attention paid to secure proper consistency. In speaking of joints, he stated that these should be formed at right angles to the axis of the road, and not at an angle of seventy to eighty degrees as recommended, citing the case of the National Pike in Licking and Muskingum counties, Ohio, as an example, where cracks are developing in the sharp angles incident to the angles formed by this practice.

W. M. Kinney of the Universal Portland Cement Company took occasion to emphasize the points brought out by Mr. Talbot, and said that more attention must be given to the mixing of materials and to the consistency of the concrete if the best results are to be obtained in the construction of the concrete road in the future. In answer to an inquiry as to the advisability of mixing the cement and sand before the stone is added, Mr. Kinney advised against this practice, giving as his reason the fact that the stone aids materially in mixing the cement and sand.

Percy H. Wilson, ex-secretary of the Association of American Portland Cement Manufacturers gave a detailed description of the dike method of curing concrete roadways, stating that it has been very successful wherever used, and that this method should be employed wherever water can be conveniently secured without cost.

The afternoon session was opened by Prevost Hubbard, of the Office of Public Roads and Rural Engineering, who questioned why the committee had not considered the use of a bituminous filler for brick pavements as well as for granite

block pavements. Major Crosby stated, as chairman of the committee that his committee proposed, untimately, to present a report covering the use of bituminous materials, as well as non-bituminous materials. Col. J. W. Howard then presented a long and very interesting discussion on brick pavements, in which he stated that he is opposed to the use of a bituminous filler, and that he does not believe that the best results can be obtained through the use of such a filler, and that the results obtained in every part of the country with the cement grout filler warrant its adoption and use without question.

William H. Connell, Chief of the Bureau of Highways of Philadelphia in continuing the discussion, called attention to the fact that it is practically impossible to get a bituminous filler in the joints of a brick pavement without smearing it all over the pavement, and that he believed that some method of applying such a filler should be devised, as he considers a bituminous filler desirable in certain instances. Mr. Connell also brought up the question of the control of plant inspection of brick.

William C. Perkins, of the Dunn Wire-Cut Lug Brick Company, stated that he is in favor of the cement grout filler, as it makes the pavement monolithic, smooth, and waterproof, and if properly applied, protects the edges of the brick from chipping off under traffic. He compared the rattler test with the method of sorting brick by color in determining hardness, and stated that consideration should be given to the new method of testing paving brick by the sand-blast test, the method for which is now being worked out by Mont Schuyler of St. Louis Testing Laboratory. Mr. Perkins also suggested that this committee, in its next report specify standard paving brick dimensions, and that he favored a surface eight and one-half by three and one-half inches as such a brick can readily be produced by all manufacturers. Regarding the shape of the paving block, Mr. Perkins stated that bar lugs and raised letters on brick are to be advised against, and that square-edged block are to be preferred to round edges, as the round edges reduce the security of the bond. He stated that he is not in favor of the use of a sand cushion under brick, but that the committee is right in recommending a sand cushion one inch in thickness instead of two inches, although it would be better to eliminate this sand cushion entirely, substituting a cement-sand bed laid dry. This method has been used most successfully in Baltimore, a one to five mixture being used, and in Cuyahoga County, Ohio, where 50,000 square yards of this type pavement were laid. The suggestion was also made that the depth of the brick paving block be reduced to three and one-half inches from the present four inches, as this would result in a considerable saving in freight, thereby reducing the cost of the brick pavement.

It was also brought out that the manufacturers of paving brick are unanimously in favor of plant inspection of brick, as this will result in a saving in all cases where brick fail to pass the prescribed tests. The manufacturers, it was stated, are taking greater care with their product, and that there are not and will not be the complaints in the future over brick not coming up to the standard.

The final discussion of the session and the meeting was on granite block and wood block, George W. Tillson, presiding. Written discussion on both types was read by Prof. Arthur H. Blanchard as prepared by Mr. Green. It was recommended by Col. J. W. Howard that instead of the committee specifying that stone blocks should be composed of medium or fine grained granite, this clause be substituted, "stone blocks should be composed of uniform grained granite that is free from laminations." Henry Welles Durham, County Engineer of Bergin County, Hackensack, New Jersey, concurred in this recommendation, and also offered some comments on the use of sand as a filler, a practice which is not recommended by the committee. Mr. Durham stated that while the use of sand should not be sanctioned as a permanent filler, it is generally permissible in temporary paving. Regarding the use of re-cut stone blocks, which the report stated "had been demonstrated to be capable of producing economical and satisfactory results and should be encouraged," Mr. Durham stated that he believed that re-cut blocks could be used in many cases and in most cities, but not in the Borough of Manhattan, owing to the fact that the old stone pavements were generally of a poor quality stone, and that the heavy traffic would prevent the re-cutting of the blocks on the work, as must be done if the work is to be economically done.

Col. Howard took up the question of fillers for wood block paving and then presented a detailed description of the processes used in treating wood block for paving. After short additional discussion by K. H. Talbot, H. S. Mattimore, Prevost Hubbard, and T. J. McGovern, the meeting was adjourned to meet again in New York next January.

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## Prevention and Repair of Street Openings and the Location and Design of Pipe Systems

George W. Tillson, Consulting Engineer to the President of the Borough of Brooklyn, New York City

MUNICIPAL engineers in charge of street paving repairs have been troubled more in keeping streets in good condition because of the openings made by the different sub-surface companies than by anything else. It being the practice in this country to lay all such structures between the curbs, constant disturbance of the pavement occurs, not only in the way of repairs, but in new work necessitated by the tearing down of old buildings and constructing new and larger ones, thereby requiring greater service from the underground structures. Openings made in the streets of the large cities of the country often require the restoration annually of pavements equal to a street thirty feet wide and 10 miles long.

As it is absolutely necessary that a large number of street openings must be made in the pavements, the important question is to have the repairs made with as little expense and interference with traffic as possible. The Borough of Manhattan, New York, requires openings to be planked after they have been refilled, so that traffic can pass unimpeded until the pavement is restored.

In Philadelphia and the Borough of Brooklyn, New York, surveys have been made of the sub-surface work, so that a knowledge can be obtained of the location of the underground structures, and when new structures are laid the work can be carried on with as little interference with the previous work and traffic as possible.

The general panaceas proposed by the layman to prevent street openings is the construction of pipe galleries. This matter was taken up in the Borough of Manhattan to quite an extent when the rapid transit subways were first studied. It was proposed to construct pipe galleries in connection with the subway on Fourth Avenue, between Worth Street and Thirty-Eighth street, at an estimated cost of $650,000. This plan, however, on account of the opposition of the various departments and the corporations, was never carried out, and after further study and attempts in other streets, the entire idea of constructing pipe galleries in connection with the rapid transit subways was given up.

A commission has been studying the matter of pipe galleries in Chicago, in connection with the proposed rapid transit subways in what is known as the Lake District, and a progress report made upon the same. This report favors the construction of pipe galleries.

Galleries for the inclusion of sub-surfacing works have been constructed in Europe since 1861, principally in the city of London. This city, however, has only a little over eight miles of these galleries, and in all Europe there are only about ten miles in use; and, with one exception, they have been put through in connection with the construction of new streets or the widening of old ones. Experience both in this country and in Europe would not indicate that the question of pipe galleries had been favorably solved.

The greatest damage to the pavements is not caused so much by the original construction of sub-surface work as by the distribution system. With all mains in the roadway, openings have to be made for all connections, both for construction and subsequent repairs. It is possible even now in this country, especially in the newer portions of our cities, to have all sub-structures built in the sidewalk, with the possible exception of water and gas mains and sewers, and these, with the exception of the sewers, can have distributing mains laid

Abstract of lecture in the Graduate Course in Highway Engineering at Columbia University, delivered on January 17, 1916 in the Assembly Hall of the Automobile Club of America, New York City.

within the sidewalk area, so that all openings need not be made in the pavement proper. In Holland and Belgium the distribution of telephone and telegraph wires is made by the use of large poles erected some hundred feet or more high, from which radiate hundreds of wires in all directions. This is not a particularly good proposition, but it does obviate to a certain extent the necessity of tearing up the pavements.

* * *

Walter Warren, of the Warren Construction Company, Portland, Oregon, builders of a large portion of the famous Columbia River Highway, has been in the East for the past six weeks, and spent considerable time in visiting roads of all types that have been built during the past couple of years in Massachusetts, Connecticut, New York, New Jersey, and Pennsylvania. His concern has a large amount of work on hand at the present time, and there is every indication that the coming road building season will be one of the busiest ever known in this part of the country.

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## Limitations of Results of Tests of Bituminous Materials

By Charles N. Forrest, Chief Chemist, The Barber Asphalt Paving Company

WE are told that bituminous materials are those which contain bitumen or yield bitumen if subjected to the process of destructive distillation and, at any rate, such a definition embraces those bituminous materials which are of interest to highway engineers. It may not be out of place at this time to explain that a rather generally accepted definition of bitumen includes as such those natural or hydrogenetic hydrocarbons and their derivatives which, if solid, melt upon the application of heat, and in any event, are soluble in carbon disulphide.

The bituminous materials which are of interest in connection with the building of highway pavements are derived from such original substances as asphalt, petroleum, or an industrial by-product tar, but are usually modified, refined, or processed in one way or another before they enter the jurisdiction of the engineer engaged in the building of such pavements.

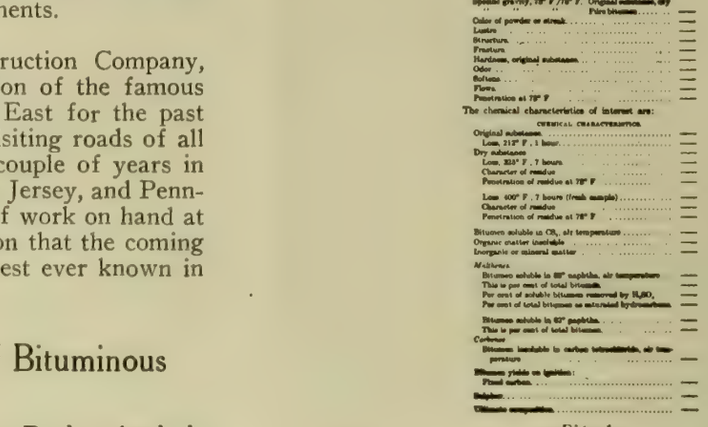
The function of such bituminous materials is quite similar in all cases when used as the binder for a mineral aggregate consisting of numerous small pieces of stone or sand, but is quite different when employed as a saturant for wood blocks.

It has already been stated (Production of Trinidad and Bermudez Lake Asphalts—Lecture to the Graduate Students in Highway Engineering, Columbia University, December 28, 1914—C. N. Forrest) that pure bitumen as such has practically no commercial application in the paving industry. In connection with street pavements it is only useful when liberally reinforced with tough, non-plastic materials such as dust, sand or stone or, as in wood blocks, with wood fibres.

It is probable that the first application of bituminous materials for paving purposes was not preceded by laboratory tests of any kind, but, at any rate, the earlier schemes for testing such substances, as are practically all the present ones, did little if anything more than identify the material under examination.

The proving of the fitness of any paving material is a matter of practical use, and requires rather a long period of time, unless it turns out a quick failure. However, the idea of using bituminous materials for highway pavements may have originated, and whatever may have been the period of time which elapsed before it was decided to test them, it is probable that as soon as a pavement was laid which was enough of a success to cause it to be conspicuous amongst a series of prior and subsequent failures, the services of a chemist were invoked to take the thing apart and determine of what "stuff" it was made. That having been done, it was but natural to endeavor to duplicate every feature of the successful experiment in all subsequent work.

The first systematic analytical work upon this subject appears to have been done by Mr. Clifford Richardson, a pioneer in the paving industry, and who took the direction of identifying the individual constituents used for the purpose, and since asphalt is a mineral substance, the tests adopted for its identification followed a scheme somewhat similar to that in general use by mineralogists, and are represented in the following statement.* (Fig. 1.)



THE MODERN ASPHALT PAVEMENT.

SOLID BITUMENS.

PHYSICAL PROPERTIES.

Specific gravity, 77° F./77° F. Original substance, dry
" " " Pure bitumen
Color of powder or streak
Lustre
Structure
Fracture
Hardness, original substance
Odor
Softens
Flows
Penetration at 77° F

The chemical characteristics of interest are:

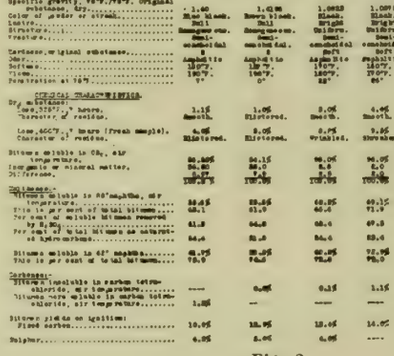
CHEMICAL CHARACTERISTICS.

Original substance
Loss, 212° F., 1 hour
Dry substance
Loss, 325° F., 7 hours
Character of residue
Penetration of residue at 77° F
Loss, 400° F., 7 hours (fresh sample)
Character of residue
Penetration of residue at 77° F
Bitumen soluble in $CS_2$, air temperature
Organic matter insoluble
Inorganic or mineral matter
Mellorites
Bitumen soluble in 88° naphtha, air temperature
This is per cent of total bitumen
Per cent of soluble bitumen removed by $H_2SO_4$
Per cent of total bitumen as saturated hydrocarbons
Bitumen soluble in 62° naphtha
This is per cent of total bitumen
Carbenes
Bitumen insoluble in carbon tetrachloride, air temperature
Bitumen yields on ignition:
Fixed carbon
Sulphur
Ultimate composition

Fig. 1

By applying this scheme of examination to all of the bituminous materials of the time, it was possible to classify them into distinct types and, whether it was the original intention to do so or not, it was entirely reasonable to view with suspicion all substances which did not closely approximate that material which was found in the most successful experimental pavement of its time, and to continue to so view them until one by one they, too, were demonstrated by practical use to be suitable for such purposes.

The following data* shows the characteristics of a number of asphalts which were examined according to the scheme under discussion a number of years ago and illustrates the possibility of classifying and identifying various bitumens by such means. (Fig. 2.)



PHYSICAL PROPERTIES AND CHEMICAL CONSTITUTION OF THE MORE IMPORTANT ASPHALTS.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test number | 65550 | 39781 | 44618 | 49748 | 55550 | 12641 | 46923 |
| Bitumen | Trinidad Lake refined | Trinidad Lake refined | Bermudez refined, 1909 | Bermudez refined, 1908 | Cuban Bajazal | California Ventura. | Mexican Maltha. |
| PHYSICAL CHARACTERISTICS. | | | | | | | |
| Specific gravity, 77°F./77°F. Original substance | 1.140 | 1.4198 | 1.0833 | 1.0975 | 1.006 | 1.0838 | 1.0438 |
| Color of powder or streak | Blue black. | Brown black. | Black. | Black. | Red-brown | Black. | Black. |
| Lustre | Dull | Dull | Bright | Bright | Dull | Dull | Bright. |
| Structure | Homogeneous. | Homogeneous. | Uniform. | Uniform. | Compact. | Uniform. | Uniform. |
| Fracture | Semi-conchoidal | Semi-conchoidal | Semi-conchoidal | Semi-conchoidal | Semi-conchoidal | Irregular. | Semi-conchoidal. |
| Hardness, original substance | 3 | 4 | Soft | Soft | 2 | 4 | Soft. |
| Odor | Asphaltic | Asphaltic | Asphaltic | Asphaltic | Asphaltic | Asphaltic | Asphaltic. |
| Softens | 212°F. | 212°F. | 140°F. | 140°F. | 250°F. | 250°F. | 200°F. |
| Flows | 180°F. | 180°F. | 180°F. | 170°F. | 240°F. | 230°F. | 210°F. |
| Penetration at 77°F | 7° | 0° | 18° | 86° | 0° | 0° | 80° |
| CHEMICAL CHARACTERISTICS. | | | | | | | |
| Dry substance: Loss, 325°F., 7 hours. Character of residue. | 1.1% Smooth. | 1.0% Blistered. | 2.0% Smooth. | 4.0% Smooth. | .80% Crusted. | 1.0% Shrunken. | 2.7% Blistered. |
| Loss, 400°F., 7 hours (fresh sample). Character of residue. | 4.0% Blistered. | 3.0% Blistered. | 6.7% Friable. | 9.0% Shrunken. | 1.0% Friable. | 2.0% Shrunken. | 6.7% Cracked bitumen. |
| Bitumen soluble in $CS_2$, air temperature | 99.59% | 94.1% | 98.0% | 96.0% | 78.1% | 99.3% | 99.0% |
| Inorganic or mineral matter | .41% | 5.9% | 2.0% | 4.0% | 21.9% | .7% | 1.0% |
| Difference | 99.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Mellorites: Bitumen soluble in 88° naphtha, air temperature | 99.6% | 99.4% | 99.8% | 99.1% | 97.6% | 97.8% | 99.7% |
| This is per cent of total bitumen | 99.6% | 99.4% | 99.8% | 99.1% | 97.6% | 97.8% | 99.7% |
| Per cent of soluble bitumen removed by $H_2SO_4$ | 41.3 | 44.8 | 48.6 | 49.8 | 40.8 | 91.6 | 48.4 |
| Per cent of total bitumen as saturated hydrocarbons | 58.4 | 52.8 | 54.4 | 53.6 | 17.8 | 8.1 | 50.3 |
| Bitumen soluble in 62° naphtha | 91.7% | 89.4% | 97.9% | 97.9% | 90.6% | 96.7% | 91.6% |
| This is per cent of total bitumen | 92.0 | 94.2 | 98.0 | 98.7 | 94.1 | 94.1 | 92.0 |
| Carbenes: Bitumen insoluble in carbon tetrachloride, air temperature | ---- | 0.6% | 0.1% | 1.1% | ---- | ---- | 17.0% |
| Bitumen more soluble in carbon tetrachloride, air temperature | 1.2% | -- | ---- | ---- | 1.2% | 1.2% | ---- |
| Bitumen yields on ignition: Fixed carbon | 10.0% | 12.0% | 12.0% | 14.0% | 60.0% | 14.0% | 19.5 |
| Sulphur | 4.0% | 5.0% | 4.0% | ---- | 6.2% | 4.0% | ---- |

Fig. 2

A similar rational scheme of examination has also been applied to the examination of non-bituminous road building materials, and the data secured by such means is of more value to the highway engineer than a bare statement of chemical composition. The ultimate analysis of bituminous and other road building materials has never been of interest to practical road builders. The function of all such materials in a road pavement is physical rather than chemical, as they are all chemically inert as far as any influences to which they are subjected in normal service are concerned.

Until within rather recent times the application of coal tar products did not receive the same scrutiny as the asphaltic materials employed in road building.

Creosote, a tar distillate, as an impregnating substance for timber has been tested for many years, and following the general plan of the earlier investigators of tar products, cresote, coal-tar, and other industrial tar pitches are still subjected to distillation in addition to a series of more distinctively physical tests somewhat similar to those used in the examination of asphaltic materials.

As the function of tar products in highway pavements is the same as that of an asphalt or a petroleum product, it is not

A lecture to the Graduate Students in Highway Engineering, Columbia University, January 31, 1916.

*The Modern Asphalt Pavement—Clifford Richardson, Page 116.
*Modern Asphalt Pavement—Clifford Richardson, Page 148.

obvious why the former should be distilled in order to determine its suitability for a given purpose, while the latter are so treated.

As a matter of fact it is now distilled, because that was part of the scheme of the original investigators in that field, and through the desire to exactly duplicate in every respect some material that was once prominently successful.

Distillation in the first instance was probably made with the view of ascertaining certain chemical properties of a tar substance, creosote, which really had a chemical as well as a physical function to perform, as a preservative of timber under some circumstances.

A more direct test for the amount of easily volatilizable constituents, and a flash test, will probably disclose whether tar pitches contain undesirable light constituents as satisfactorily as those tests are represented to do in the examination of asphaltic materials and petroleum products.

The variety of bituminous materials available for road building purposes is now very much greater than it was a decade ago. The manner of their application has also enlarged and the suggestion of new methods for testing them has added a number of additional features to the earlier schemes, but even so, there are few tests employed in the general examination of bitumens which can be said to directly indicate quality for any specific purpose. Some of them are very properly referred to as indirect indications of quality, but after all, as the subject now stands, the only real test of quality still remains a service test over a period of years.

Following the introduction of the many new products or so-called paving bitumens, during the past ten years, each one of which has generally appeared with many claims of superiority, there has been a marked tendency to contract the general scheme of testing which was in vogue prior to their introduction, in order that those characteristics which such schemes indicated were essential, but did not happen to fit some specific new product could be ruled out.

The deliberations of associations of learned societies which have had such matters as the drawing of specifications and schemes for testing materials under consideration, and are necessarily obliged to assume a neutral position, has resulted in first, the elimination of all features which are not common to all substances of a certain class which have not been an absolute failure in service and, second, the extension of the limits of specifications to a sufficiently wide range to include everything which has any sort of a favorable indorsement.

The recommendations of such bodies are always a compromise and generally reflect average, rather than the most advanced thought or practice.

As an illustration of the considerable abbreviation of present-day specifications, the recommendations of the American Society for Municipal Improvements for suitable asphalt for sheet asphalt pavements may be quoted. It is as follows: (Fig. 3.)

SPECIFICATIONS AM. SOC. MUN. IMP.
1914.

| Refined Asp. | Asp. Cem. | Flux. |
|---|---|---|
| Prepared from natural mineral bitumen. | Refined asphalt and flux. | Residue of Petroleum. |
| Pen.at 77°F., Solubility $CCl_4$. | Pen.at 77°F., Flash. Volatilization. Hardness after volatilization. Ductility. | Pen.at 77°F., Sp.Gravity. Volatilization. Flash. Solubility $CCl_4$. |

Fig. 3

This is a typical example of a compromise specification and one which is popularly described as open, because a great variety of substances fall within the scope of its limitations, both in regard to common characteristics and the wide latitude of the few of them which have been mentioned.

A more elaborate specification or scheme of examination is illustrated in the form of report of the Office of Public Roads* for bituminous materials for different purposes. These are as follows: (Fig. 4 & Fig. 5.)

At the present time practically all of the tests applied to bituminous road materials, by those who are concerned in their application in road building, come within the classification of proximate analysis, and do not disclose the ultimate composition of the substance. They merely reveal certain of its char-

*Bulletin 314, U. S. Dept. Agriculture—"Methods for the Examination of Bituminous Road Materials"—Hubbard & Reeve.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF PUBLIC ROADS AND RURAL ENGINEERING,
Washington, D. C

Sample No.

Report on.....
Identification mark.....
Known as.....
Submitted by.....
Examined for.....

General character.....
Specific gravity 25°/25°C.....
Melting point °C.....
Flash point °C.....
Burning point °C.....
Viscosity at..... °C.....; c. c. specific.....
Ductility at 25°C. (cm.).....
Float test at.... °C. time....; at.... °C. time...
Penetration at 25°C. (mm.).....
.....

Loss at..... °C..... hours.....
Character of residue.....
Consistency of residue { Float test at..... °C.. / Penetration at 25 °C. (mm.)
Bitumen soluble in $CS_2$.....
Organic matter insoluble.....
Inorganic matter insoluble.....
% of total bitumen insol. in 86° naphtha.....
% of total bitumen insol. in $CCl_4$.....
% fixed carbon.....

Remarks.....

Date received..... , Date reported .....

Analyst .....

Fig. 4

acteristics, chiefly physical, when applied in a very strict accordance to some prescribed method. A rather similar instance is in the examination of coal in which the volatile hydrocarbons, the fixed carbon, etc., are determined.

A great deal of time and thought has been given to the question of standardization of the methods employed in such

Form 103-B.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF PUBLIC ROADS AND RURAL ENGINEERING,
Washington, D. C

Date

Sample No.....
Report on.....
Identification mark.....
Known as.....
Submitted by.....
Examined for.....

General characteristics.....
Specific gravity 25°/25°C.....
Melting point °C.....
Flash point °C.....
Burning point °C.....
Viscosity Engler at.....°C.....c. c. specific.....
Consistency { Float test.....°C., time.....; .....°C., time / Penetration 25 °C., 100 gms., 5 seconds
Loss at 163°C., 5 hours.....
Character of residue.....
Consistency of residue { Float test.....°C. time.....°C., time / Penetration 25 °C., 100 gms., 5 seconds
Bitumen soluble in $CS_2$ (total bitumen).....
Organic matter insoluble.....
Inorganic matter insoluble.....
Per cent of total bitumen insoluble in 86° B. naphtha.....
Per cent of total bitumen insoluble in $CCl_4$.....
Per cent fixed carbon.....
Distillation—

| | Character | % by vol | % by wt |
|---|---|---|---|
| Water | ..... | ..... | ... |
| First light oils ..( -110°C.) | ..... | ..... | ... |
| Second light oils (110°-170°C.) | ..... | ..... | ... |
| Heavy oils.....(170°-270°C.) | ..... | ..... | ... |
| Heavy oils.....(270°-300°C.) | ..... | ..... | ... |
| Pitch | | | .... |

Remarks.....

Fig. 5

proximate analyses by individuals as well as such associations as the American Society for Testing Materials. The standardization of methods for testing is actually of more importance than the drawing of general specifications, as there can be no common understanding of specifications until there is unanimity of opinion as to how the characteristics mentioned in them are to be determined. The manufacturer generally has more accurate knowledge of his particular product than the consumer, as the large companies, at least, maintain very complete research laboratories and are very keenly interested in the ultimate as well as the proximate composition or characteristics of their raw materials and finished products, but when they come in contact with the consumer, a definite understanding of what the consumer's specifications mean is very necessary for amicable business relations.

A general classification of the bituminous materials of the present time, and the purposes for which they are used in road building is as follows:

Dust Palliatives—Thin liquids applied to road surfaces without heating, as straight oils or watery emulsions.

Surface Applications—Thin liquids applied without heating and subsequently covered with sand or fine stone or equivalent material.

Surface Applications—Thick or heavy liquids applied hot and subsequently covered with sand or fine stone or equivalent material.

Binders—Semi-solid bituminous materials mixed either hot or cold with broken stone for bituminous concrete, bituminous macadam, sheet asphalt, asphalt block.

Impregnators—Liquid substances used for the impregnation of wood paving blocks.

The separation into two major divisions of the substances mentioned is as between, tar products, coal, water gas, and other by-product tars, and petroleum and asphaltic products. A great many sub-divisions of both of these two major divisions has been made or attempted, but these need not be considered at this time.

Many of the tests employed in the routine examination of bituminous materials are applicable to both major classes. These are as follows:

Specific Gravity.
Flash and Fire Point.
Penetration. } semi-solids.
Melting Point } semi-solids.
Ductility. } semi-solids.
Loss on heating and consequent hardening.
Viscosity.
Cementitiousness.
Brittleness.
Solubility.
Distillation.

Tar products, as has been remarked previously, are sometimes required to show certain characteristics upon fractional distillation, and the oils used for the impregnation of wood paving blocks, a certain amount of tar acids, naphthalene, or other constituents.

In addition to the foregoing tests, petroleum and asphaltic substances are sometimes submitted to tests for sulphur, paraffines, fixed carbon, and other more distinctly chemical features.

The standardization of the methods for performing the tests enumerated has not yet been satisfactorily accomplished, but is progressing slowly, and in the meantime a full description of the method which is to be employed for the determination of the characteristics mentioned should accompany all specifications, if confusion is to be avoided.

That there is considerable of divergence of opinion as to the most suitable method for performing many of the tests, and a still greater divergence upon the results obtained, is appreciated by all who have been concerned either in the manufacture, sale, or purchase of bituminous materials for any length of time.

There is not much room for honest disagreement upon the subject of specific gravity yet in view of the fact that that characteristic varies with temperature and such viscous substances, as many of those involved are, are prone to entangle air and moisture, there has been more or less controversy over this simple matter. As this characteristic of bituminous materials frequently plays an important part in the computation of quantity delivered and slight errors in the laboratory determination of specific gravity multiply into very considerable differences between what is shipped at one point and received at another, it is worthy of careful consideration.

The temperature of bituminous materials affects practically all of the physical tests to which they are subjected, and too much care cannot be exercised to insure the specific temperature specified, being the actual condition of the material under examination and not merely that of the surrounding air or water which may envelope it at the time. This class of material absorbs and radiates heat slowly and the period of time stated in a method, through which a sample is to remain in water, or the procedure to be followed in heating or cooling it must necessarily be based upon considerable experience in such matters and must also be religiously followed if accuracy is important.

While there may not be much room for honest disagreement upon the subject of specific gravity, there is no limit to either the room for or the degree of disagreement in regard to practically all of the other tests to which bituminous materials are submitted.

In addition to the dozens of miscellaneous independent methods used for the determination of the flash or fire point, or both, there are as many as at least eight more or less standard methods for the same purpose which may be described under the name of the apparatus used for the purpose. The eight standard methods are as follows:

Tagliabue—open and closed cup.
New York State closed cup.
Cleveland open cup.
Abel closed cup.
Abel-Pensky closed cup
Pensky-Martin closed cup.
Bureau of Mines closed cup.

No open cup method will yield results capable of duplication in the hands of different operators, and the value of any results so obtained is questionable. The results obtained under unlike conditions, either as to type or cup, or its manipulation, are not comparable. The closed cup tests can be checked to a single degree.

At the present time there are several different instruments* and methods for the determination of the consistency of penetration of bituminous materials, although but one of each is in general use. As is well known, the principal of this test is to determine the depth to which a standard needle under a definite load will penetrate at a stated temperature and in a stated period of time. There are several variables or opportunities therefor in this test, and these must be taken care of at the outset. The consistency of bituminous materials is an adjustable characteristic and, without consideration of any other feature, may be regulated in terms of the apparatus referred to, to any degree stated, but as to what is a proper penetration for a given material or a stated purpose, depends entirely upon experience with both that material and purpose and where the purpose is located.

The penetration of different classes of bituminous materials is not always a correct indication of their relative consistency, due to the fact that very adhesive substances retard the progress of the needle, by clinging to its sides, while more oily and obviously harder substances may encourage its progress. The diameter and depth of the vessel in which the substance under examination is tested, and whether its surface is covered with water or exposed to the air, may also influence the result.

Disagreement in the results of this test by different operators is more frequently due to the temperature variations in the sample than any other cause, although a dull needle, too small sample, or lack of the "knack" of manipulating the test are sometimes contributory causes. Some experience is necessary to perform the test satisfactorily. After all conditions are correct, it is conceded that a difference of four points is a satisfactory agreement between different operators.

The number of different methods which have been proposed for the determination of the so-called melting point of bituminous materials probably exceeds that of flash point methods. Those with which the author is familiar are as follows:

Cube on mercury.
Mabery.
Kramer & Sarnow and modifications.
Ball and ring and modifications.
Cube in water.
Cube in air.
Coated bulb and modifications.
Wendringer.
New York Testing Laboratory.

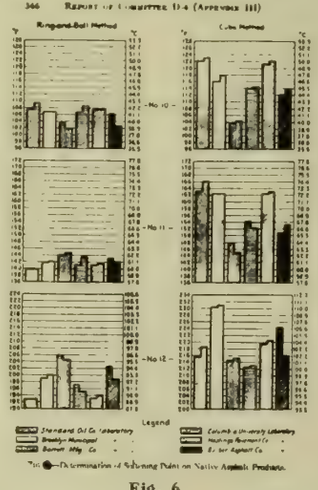


Fig. 6

Nearly every laboratory has its own "pet" scheme for this test, and inasmuch as bitumens have no true melting point, because they are mixtures or combinations of many different hydrocarbons and other things, any one of the methods which have been proposed is about as good as any of the others in the hands of a single operator, but no two of them yield com-

*School of Mines Quarterly, Vol. 10, P. 297, Bowen Pen. Machine.
Proc. Am. Soc. T. M., Vol. 3, P. 349, Dow Machine.
Proc. Am. Soc. T. M., Vol. 7, P. 626, N. W. T. L. Penetrometer,
Proc. Am. Soc. T. M., Vol. 9, P. 600.
Proc. Am. Soc. T. M., Vol. 11, P. 676, Abrahams Consistometer.

parable results, and no one of them in the hands of different operators will agree, unless every detail of the test is scrupulously adhered to.

The following data from the report of a sub-committee of Committee D-4, Am. Soc. T. M.,* upon the subject of melting point, illustrates the great variation which was found to exist between two rather widely-used methods in the hands of several different operators in a series of co-operative experiments upon the same material. (Fig 6.)

While at least three different methods for the determination of ductility have been proposed, only one of them is in general use. The three methods referred to are the Dow, Cross, and Abrahams, the first mentioned being the most popular. The Cross and Abrahams methods both employ cylindrical test specimens, while the Dow method involves the use of a briquette having a square cross-section at its narrowest part, and taking a flattened hour-glass form.

The results upon the same material as tested by these three methods are not comparable, but some recent co-operative work with the Dow method (Report of a Sub-Committee of Com. D-1, A. S. T. M., Vol. 15, Part 1) seems to indicate that results varying from 5 to 40 c.m. were obtained by six different operators upon the same material.

The results in question are as follows: (Fig. 7.)

—Results of Tests for Ductility.

| Sample No. | Ductility Determined by Different Observers, centimeters pulled before rupture. | | | | | |
|---|---|---|---|---|---|---|
| | Kershaw. | Gure. | Broadhurst. | Pullar. | Kleeburg. | Dow |
| 10923 (Test A) | 55 | 40 | 30[a] | | 53 | 52 |
| | 58 | 46 | 36 | 40 | 52 | 53 |
| | 82 | 48 | 42 | 52 | 48 | 57 |
| 10923 (Test B) | 51 | 54 | 35 | .. | 46 | 46 |
| | 59 | 48 | 35 | .. | 53 | 60 |
| | 75 | 44 | 36 | .. | 48 | 69 |
| 11020 | 26 | 24 | 22 | .. | 22 | 20 |
| | 30 | 26 | 28 | .. | 22 | 21 |
| | 30 | 24 | 21 | .. | 23 | 24 |
| | 23 | 25 | .. | .. | 23 | 24 |
| | 28 | 23 | .. | .. | 24 | 24 |
| | 30 | .. | .. | .. | 17 | 21 |
| 11018 | 68 | 45 | 70 | .. | 39 | 78 |
| | 70 | 52 | 66 | .. | 37 | 77 |
| | 68 | 46 | 56 | .. | 32 | 73 |
| | 45 | 44 | .. | .. | 34 | 78 |
| | 50 | .. | .. | .. | 33 | 77 |
| | 54 | .. | .. | .. | 34 | .. |
| 10923 | 52 | 40 | 61 | .. | 31 | 62 |
| | 54 | 41 | 60 | .. | 32 | 46 |
| | 66 | 46 | 44 | .. | 40 | 60 |
| | 39 | 43 | .. | .. | 34 | 47 |
| | 54 | .. | .. | .. | 36 | 47 |
| | 67 | .. | .. | .. | 38 | 52 |

[a] This sample was checked by Dow, who obtained the same results as Broadhurst, showing that the sample was lower in ductility than those sent to the other observers.

Fig. 7

The loss on heating test is one which has been the subject of considerable disagreement chiefly on account of the great variety of apparatus used for the purpose. It would seem to be a very simple matter to weigh out a definite amount of material and expose it in a suitable container to a stated temperature for a stated period of time, but the difficulty lies in the fact that the diameter and depth of the container influence the amount of loss, and the ovens in which the heating is done are of all sorts as regards temperature uniformity and air circulation. During the last couple of years a collection of boxes used by different analysis in making the volatilization test has been assembled. They are of the following sizes: (Fig. 8.,)

VARIATION IN SIZE OF HEATING DISHES.

| | DIAMETER. | HEIGHT. | CORNERS. |
|---|---|---|---|
| 1. | 4.4 c.m. | 1.5 c.m. | Round. |
| 2. | 5.6 c.m. | 3.4 c.m. | Square. |
| 3. | 6.0 c.m. | 1.9 c.m. | Square. |
| 4. | 6.5 c.m. | 2.2 c.m. | Square. |
| 5. | 6.5 c.m. | 4.3 c.m. | Square. |
| 6. | 6.9 c.m. | 2.5 c.m. | Round. |
| 7. | 7.6 c.m. | 2.5 c.m. | Square. |

Fig. 8

Probably the two types of ovens which are in most general use are the New York Testing Laboratory gas-heated, cylindrical oven, and the Freas electrically-heated rectangular oven. The former was adopted as standard for this test by the American Society Testing Materials several years ago, but since that time the Freas and other electrically-heated ovens have appeared and are now in general use. (Fig. 9 & Fig. 10.)

*Proc. A. S. T. M., Vol. 15, Part 1.

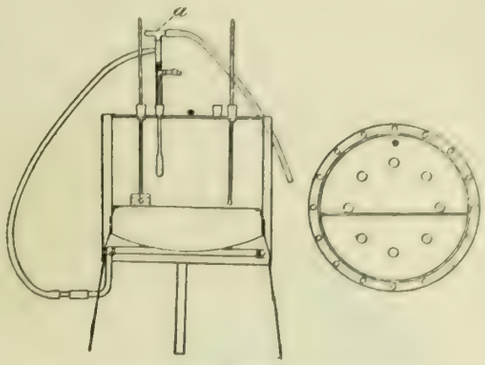


Fig. [illegible]—New York Testing Laboratory oven

Fig. 9

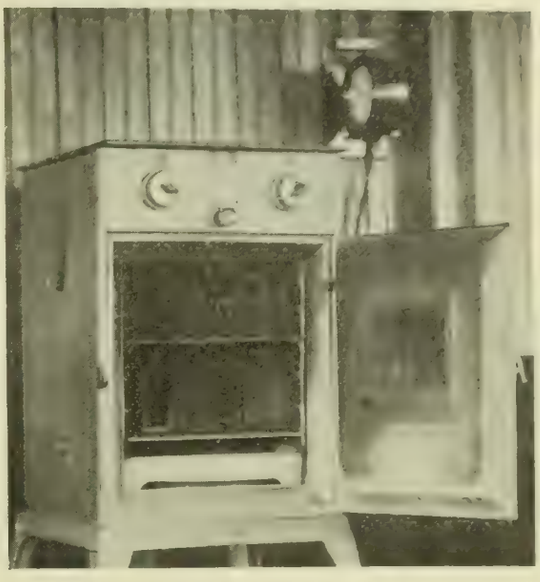


Fig. 10

The cause of the discrepancy in results in the Freas oven has been ascribed by Mr. Norman Chivvos,* Chief Chemist, Municipal Testing Laboratory, St. Louis, Mo., to "the presence of conviction currents set up inside the oven." The variation in loss from a number of samples of the same material is given as follows: (Fig. 11.)

Variations in Evaporation Loss Depending on Position of Sample in Oven

| Top Shelf | Lower Shelf | Back of Oven | Middle of Oven | Front of Oven |
|---|---|---|---|---|
| 8.2 | 9.0 | 8.2 | 5.1 | 4.6 |
| 4.6 | 8.2 | 9.6 | 6.6 | 6.5 |
| 6.5 | 9.2 | 9.1 | 9.7 | 6.4 |
| 4.5 | 9.9 | 15.8 | .. | 4.5 |
| 12.0 | 7.2 | 16.6 | . | 5.9 |
| 5.1 | 4.0 | 12.0 | | 4.4 |
| 6.6 | 9.6 | 13.7 | . | 5.7 |
| 13.7 | 9.1 | 10.8 | . | 4.0 |
| 9.7 | 6.4 | 6.3 | .. | 6.2 |
| 5.9 | 15.8 | 9.9 | . | 6.4 |
| 4.4 | 16.6 | 7.3 | . | 9.0 |
| 5.7 | .. | 8.4 | . | .. |
| 10.8 | . | 9.2 | .. | . |
| 6.3 | . | 8.2 | .. | .. |
| 8.4 | .. | .. | . | . |
| 6.2 | .. | .. | .. | .. |
| 6.4 | .. | .. | . | .. |
| Average 7.4 | 9.5 | 10.4 | 7.1 | 5.8 |

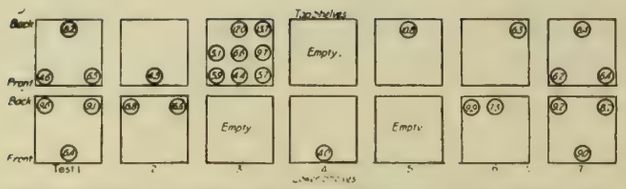
Fig. 11

The position of the sample in the oven, which is the chief factor in the cause of the variation found, is shown in the following diagram: (Fig. 12.)

It is obvious that the temperature or the circulation inside this type of oven is not uniform, and that a thermometer in a fixed position will not indicate the true condition of affairs.

In order to circumvent the eccentricities of the oven, a revolving shelf has been devised and installed by Mr. Roy

*Road Oil Test for Loss on Heating Needs Revision, Engineering Record, Vol, 72, P. 570.




LOSSES OF WEIGHT ON EVAPORATION VARIED GREATLY WITH POSITION OF CONTAINER IN OVEN.
Figures in circles, which indicate positions, show per cent loss

Fig. 12

Fitch of the U. S. Bureau of Standards, in the Freas oven in that laboratory. This modification is illustrated in Fig. 13.

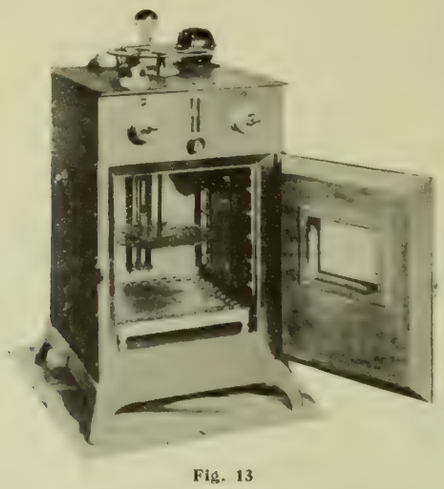


Fig. 13

The shelf is made of a perforated disc of aluminum and is hung midway in the oven from a vertical shaft which revolves in a fixed bearing in the top ventilator. The samples under test are arranged single file around the shelf and the whole outfit is revolved at the rate of 5-6 r.p.m., throughout the entire test. The power is a small 1-100 h.p. motor, geared directly to the shaft. Under these circumstances every sample in the oven is in the same position for the same length of time during test, and two sources of error appear to have been thus minimized, if not entirely removed. Concordant results are impossible if the amount of material, the diameter and depth of the box or dish, and the temperature and circulation of air are not exactly the same in every instance.

The penetration of the residue after the loss on heating test has been performed is, of course, subject to the same errors as surround that test at all times. It is also affected, however, by the depth of the material under observation, and if this test is to be performed, a quantity sufficient to provide depth for the purpose should be taken in the beginning.

The maximum depth in millimeters of 20 and 50 grams, respectively, of a few of the bituminous materials used in road building, in boxes of different diameters is as follows: (Fig. 14.)

DEPTH OF MATERIAL IN HEATING DISHES OF DIFFERENT DIAMETER.

| Diameter of dish. | 2.5 inches. | | 2.25 inches. | |
|---|---|---|---|---|
| Amount of material. | 20 Grs. | 50 Grs. | 20 Grs. | 50 Grs. |
| Depth of light flux. | 8 m.m. | --- | 20 m.m. | 50 m.m. |
| Depth of heavy flux. | 6 m.m. | 20 m.m. | 9 m.m. | 23 m.m. |
| Depth of 1.25 Sp.Gr. A.C., (50 Pen.) | 5 m.m. | 8 m.m. | 6 m.m. | 16 m.m. |
| Depth of 1.08 Sp.Gr. A.C., (50 Pen.) | 6 m.m. | 16 m.m. | 7 m.m. | 18 m.m. |
| Depth of 1.08 Sp.Gr. A.C., (140 Pen.) | 6 m.m. | 16 m.m. | 7 m.m. | 18 m.m. |

Fig. 14

As 20 grams of asphalt cement in a dish 2½ inches in diameter is but 6 to 7 m.m. deep, or the equivalent of 60 to 70 penetration, it is obvious that such material cannot lose the amount permitted by many specifications in the heating test and still be of sufficient depth for the penetration test. The fact that the needle strikes and stops upon the bottom of the dish is not always appreciated and has led to controversy or unfavorable criticism in some instances.

There are a great variety of instruments available for indicating the viscosity of bituminous materials, and while no particular type has been officially adopted for testing road materials, the "Engler" is more generally used for that purpose than any other. In addition to the Engler, the Lawrence, Redwood, and Saybolt are sometimes mentioned in specifications for road building materials.

None of these instruments speak the same language, but there is no reason for disagreement between different operators of laboratories with the same type instrument, if the standard directions for its operation are observed by both sides.

The relation of several of the more widely employed viscosimeters to each other has been worked out and published in the Proceedings of the American Society Testing Materials, Vol. 15, Part 1. The following table by C. W. Waidner gives the ratio of efflux for the Saybolt and Redwood as compared with the efflux of the Engler: (Fig. 15.)

TABLE I.—EXPERIMENTALLY DETERMINED RATIOS OF MEAN EFFLUX TIMES FOR FOUR ENGLER VISCOSIMETERS (MEAN WATER VALUE 51 SECONDS), TO THE MEAN EFFLUX TIMES FOR THREE SAYBOLT UNIVERSAL, AND TO THE MEAN EFFLUX TIMES FOR TWO REDWOOD VISCOSIMETERS.

| Efflux Time for Engler, seconds. | Ratio of Engler Time to Saybolt Time. | Ratio of Engler Time to Redwood Time. |
|---|---|---|
| 50 | 1.83 | 1.92 |
| 52 | 1.81 | 1.90 |
| 54 | 1.79 | 1.89 |
| 56 | 1.77 | 1.88 |
| 58 | 1.76 | 1.87 |
| 60 | 1.74 | 1.86 |
| 62 | 1.72 | .... |
| 64 | 1.71 | .... |
| 65 | .... | 1.83 |
| 66 | 1.70 | .... |
| 68 | 1.68 | .... |
| 70 | 1.67 | 1.81 |
| 75 | 1.63 | 1.79 |
| 80 | 1.60 | 1.77 |
| 85 | 1.58 | 1.76 |
| 90 | 1.55 | 1.75 |
| 95 | 1.53 | 1.74 |
| 100 | 1.51 | 1.73 |
| 105 | 1.49 | 1.72 |
| 110 | 1.48 | 1.71 |
| 120 | 1.46 | 1.70 |
| 130 | 1.44 | 1.69 |
| 140 | 1.43 | 1.68 |
| 150 | 1.41 | .... |
| 160 | 1.40 | 1.67 |
| 180 | 1.39 | 1.66 |
| 200 | 1.38 | 1.65 |
| 220 | 1.37 | 1.64 |
| 300 | 1.36 | 1.63 |
| .... | .... | .... |
| 3500 | 1.36 | 1.63 |

Fig. 15

The direct determination of the cementitious properties of bitumen has been attempted by different investigators in a variety of ways, and a recent form of such test which is applicable to road surfacing oils is the Osborne test, devised by Clarence B. Osborne,* Chemist for the State Highway Department, California, and applied in the examination of the heavy oils or liquid asphalt used extensively in that State.

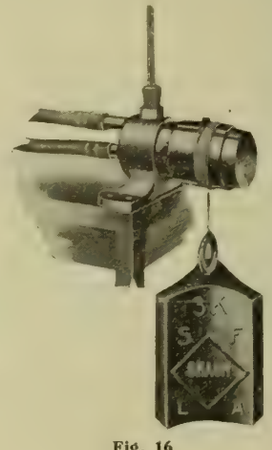


Fig. 16

The Osborne apparatus is illustrated in Figure 16—and consists of a horizontal hollow brass spindle 2" diameter by 3" long, through which water at 77° F. is circulated, a brass collar 2" long by 2.01" inside diameter, which fits loosely over the spindle, and a three kilo weight attached by a cord to an eye on the collar. The brass spindle and inside of the collar are coated with the oil under examination, and the latter is then slipped over the spindle. The cord holding the weight is wrapped about the collar and when the weight is released the time elapsed in seconds while the collar makes three revolutions is recorded. Results can be checked within a few seconds, and the more cementitious materials interpose greater resistance to the movement of the collar than less cementitious ones of the same consistency. As this device is arranged at present, it is not available for testing the semi-solid bituminous cements or binders for macadam type of construction. A

*Road Oil Specifications and Tests—Engineering News—Vol. 72, P. 342.

series of tests performed in the writer's laboratory upon a number of heavy oils of about the same consistency available in the East gave the following results:

| *Heavy Oils* | *Osborne Tests* |
|---|---|
| 1 | 770 Seconds |
| 2 | 600 Seconds |
| 3 | 250 Seconds |
| 4 | 175 Seconds |

The more bituminous materials are tested for adhesive properties by several experimenters by cementing two brass cylinders or prisms, having an era of one square inch, together with as little of the hot bituminous material as will remain between the parallel faces of two such metal sections when a regulated amount of pressure is applied. After adjusting the temperature of the test piece so prepared, the cylinders are pulled apart in a suitable apparatus, such as a tensile machine for breaking briquettes of hydraulic cement. A large number of tests of the same material must be made to secure a fair average, and abnormally low and high results should be discarded. Variations amounting to several hundred pounds frequently occur.

A test of this character is employed by Mr. G. P. Henstreet, of the Hastings Pavement Company, in the control of the manufacture of asphalt blocks, and also by Dr. Kleeburg, Chemist, Bureau of Highways, Borough of Manhattan, but the specifications of municipalities for paving materials have not, so far, included such a requirement.

A test for brittleness is not usually mentioned in connection with bituminous road building materials, but is in use by some investigators for special purposes. One type of such a test is performed at some specific temperature by resting a small prism of the bituminous material upon knife edges standing a definite distance apart, and striking it midway with a ball weight falling a prescribed distance. This test was probably devised in the asphalt laboratory of the District of Columiba, but at any rate, the author is indebted to Mr. J. O. Hargrove, chemist in charge of that laboratory at the present time, for the drawing of the device making the test shown in Figure 17.

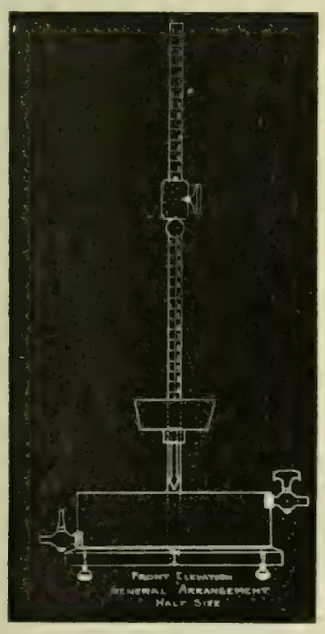



Fig. 17

Another type of test for brittleness is in use in the laboratory of the Highway Department, State of New York, and elsewhere, and is applied to semi-solid bituminous materials of a considerable range of consistency. In carrying out the test six or eight cylinders 1.25 or 2.00 inches in diameter and of equal height are cast in a split mold and after they are adjusted to a standard temperature, usually 32° F. are removed from the mold and broken under a Page impact or similar machine. A large number of individual tests upon the same material is necessary to arrive at a fair average.

Bituminous materials are tested in a variety of complete and partial solvents with certain objects in view. The universal solvent for bitumen is carbon-disulphide, and bituminous materials and mixtures are therefore treated with that solvent for the purpose of ascertaining their bitumen contents. The bitumen contents of such materials is that portion which is so soluble. Benzol and chloroform are also complete solvents for bitumen, and are sometimes employed for that purpose, but carbon disulphide is in more general use and has wider approval. Carbon tetrachloride does not always dissolve as much of a bituminous material as carbondisulphide.

Petroleum naphtha, acetone, and ethyl-ether, are only partial solvents of bitumen. The former has been employed extensively in the examination of bituminous materials, but the test is subject to wide variation in the hands of even an experienced analyst, unless the temperature of the solvent, its gravity or limits of boiling point and general nature are collectively always the same.

The results of solubility tests of a given bitumen in 70° naphtha and 80° naphtha are not comparable, nor are the results the same in duplicate tests if one naphtha has been derived from a paraffine oil and the other from an asphaltic oil.

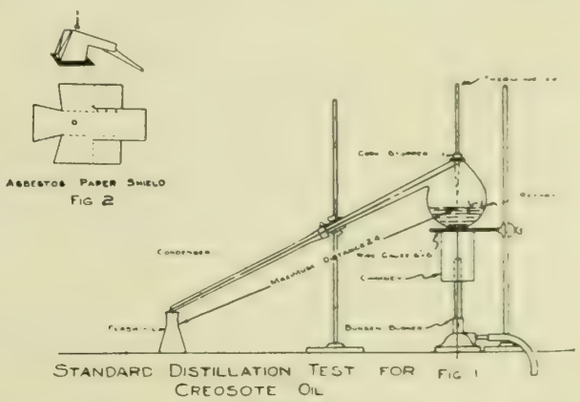
The solvent action of ethyl-ether upon a given bitumen is constant regardless of temperature and, as ethyl-ether is a definite chemical substance having a definite boiling point, the only precaution necessary in the use of that solvent to insure positive results is to employ pure ethyl-ether. A common impurity is ethyl alcohol.

The same thing is also true of acetone or any other definite chemical substance.

There are no limits to the possible variations in such tests if the solvents employed are impure or the tests are performed in a careless manner.

Bitumen may be fractionated by subjecting it to the action of such solvents and partial solvents as have just been described, but the fractionation of tar products is usually accomplished by a process of distillation. This is especially true of the oils used for the impregnation of wood paving blocks. As a research matter distillation in the laboratory of all kinds of bituminous materials has been a source of considerable information, but as a routine test, is impractical in the examination of road building materials, except upon certain tar and "cut back" oil products.

There is a diversity of opinion as to the type of apparatus which should be used for this purpose. The arrangement of retort and condenser shown in Figure 18, has been used for




STANDARD DISTILLATION TEST FOR FIG 1 CREOSOTE OIL

Fig. 18

the distillation of tar oils for a great many years and is now under consideration for adoption as standard by several associations interested in the subject. It is subject to considerable criticism on account of the difficulty of obtaining retorts of proper shape and size. A side neck distilling flask is more susceptible to standardization and has been so generally adopted in the petroleum industry that a vessel of that character should perhaps be employed in the examination of wood-treating oils. The flask and arrangement of the complete apparatus shown in Figure 19 has been recommended by the Sub-Committee on Distillation of Committee D-4 of the American Society Testing Materials. Under the most favorable circumstances of ordinary laboratory procedure, the fractionation of oils in either type or apparatus, in the absence of an efficient dephlegmator, will not differentiate sharply the various constituents of the oil as to boiling point or the amount thereof present.

It has been stated* that "the ultimate utilization of tests for the purpose of selecting material for a given use makes it necessary that (1), the test limits adopted shall specifically define the material, and (2) that the material thus defined shall have previously proved satisfactory for that particular purpose."

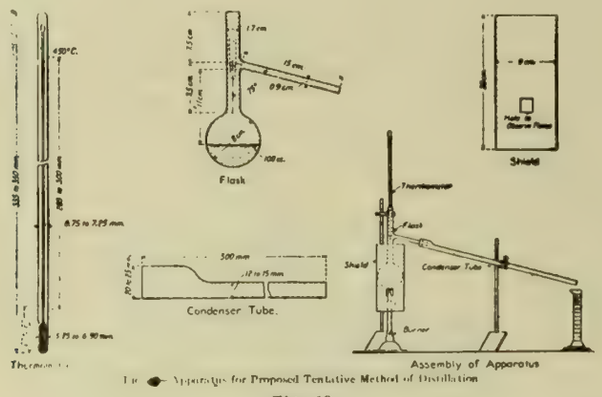



Fig. 19

Under the above circumstances, it is obvious that such tests as have just been discussed do not per se, disclose the quality of a bituminous material for any specific purpose. The characteristics determined by such tests are usually common to all bituminous substances, good, bad, and indifferent.

One will only differ from another in degree, and the extent of such differences, in view of the limitations of the tests now in use, will depend a great deal upon the experience and skill of the analytist making them. With very few exceptions none of the tests are conclusive, nor the data as a result of their application even instructive, unless it represents a large number of observations upon the same material. Freak results are often encountered, and such should be eliminated in computing the average result of any tests susceptible of producing freaks.

Professor A. H. Blanchard in his very excellent book, "Elements of Highway Engineering," has quoted Mr. Prevost Hubbard upon the subject, "Interpretation of Results of Tests," and the following remarks from that source upon the significance of a number of tests which are now under discussion are of interest:

Specific Gravity—"It is of value mainly as a means of identification" . . . .

Flash Point—"This determination is of little value, other than a quick means of differentiating between heavy crude oils and cut back products and fluid residuums" . . . .

Melting Point—"A determination of melting point of solid bitumen is mainly of value as a means of identification, and for control work on the part of manufacturers."

Consistency—"Maximum and minimum limits covering consistency are essential." (Consistency as here referred to embraces penetration or viscosity.)

Distillation—"The distillation test as applied to tars is a very valuable one both for the purpose of ascertaining their road building properties and method of preparation if they are refined products."

Solubility Carbondisulphide— . . . . "The solubility of bitumen itself is entirely independent of its character and consistency."

Solubility 88° B. Naphtha—"As applied to oils and oil products, this determination is of value as indicating the amount of body-forming hydrocarbons which give mechanical stability to the material."

Evaporation—"This test is a purely arbitrary one, but when applied to road oils will often prove of considerable value."

Fixed Carbon . . . . "shows much the same thing as naphtha-insoluble bitumen" . . . .

Supplementing the above estimate of the value of certain tests by Mr. Hubbard, a quotation from Messrs. Dow & Smith* upon the subject of paraffine is given by Professor Blanchard as follows:

Paraffine—"We are decidedly of the opinion that the scale paraffine test per se should not be regarded as a measure of value of bituminous compounds for road-making or paving purposes."

Upon inspection of the specifications of the American Society Municipal Improvements for asphalt cement for sheet asphalt pavements it will be observed that but few of the tests which have just been discussed are mentioned. Those which are mentioned, or which affect the asphalt cement through being mentioned under the requirements for refiined asphalt or flux, which combine to produce the asphalt cement are, Penetration, Evaporation, and Ductility. These are characteristics which are common to all bituminous materials and, in the light of the available information upon this general subject, cannot be regarded as furnishing conclusive evidence of suitable quality of any or all materials for such a purpose.

The drift of this subject during the past few years, during which time one after another of the tests which did not happen to suit some new material, as it had theretofore been interpreted, has been thrown into the discard, rather brings us abreast with the fact that a great deal of attention is being paid to the testing of an element which forms but a small part of an article of manufacture, namely, the pavement in place and ready for work, which might perhaps be devoted with the hope, at least, of more positive results upon the finished article as a whole. The bituminous binder employed in road building is modified to such an enormous extent by the mineral aggregate with which it is associated that its suitability or its quality for any specific purpose cannot be estimated without consideration of the mineral aggregate, and the conditions of service which it is required to meet.

As a matter of fact there is considerable additional, frequently unconfessed, work required by one who is obliged to approve of a bituminous material offered as being in compliance with such abbreviated specifications as are some of those of the present time.

The amount of laboratory work required to ascertain whether a material does or does not comply with such specifications is small, and the question of mere compliance is much simpler and of less actual importance than that of quality.

Bituminous pavements which are prepared locally and put down in sheet form; that is, as a unit, do not lend themselves readily to testing as a whole or as a complete mixture, but it is obvious that a series of tests which can be applied to the finished article of manufacture, namely, the whole mixture or the pavement in place, would be much more conclusive and satisfying from the point of view of the engineer who is responsible for the work, than the type of tests now in vogue, confined as they are to the raw materials as separate units, and give no direct information as to how congenial such raw materials will be after they are combined.

There is a definite understanding on the part of engineers as to the function of a bituminous pavement, and it would not be a difficult matter to forecast rather closely the probable punishment it will receive in service. A series of tests which could be applied to the finished pavement or to the complete mixture which is to form the pavement would be of infinitely more value to the engineer than any information developed by present-day procedure.

The manufacturer of a pavement must know what raw materials to bring together to produce the results demanded by the purchaser of his product, but at the present time "The Limitations of Results of Tests of Bituminous Materials" for road building are such that after the results are obtained, the purchaser of the finished article must still select the bituminous material for use therein by reputation for good service, and in any event wait a number of years for a positive answer as to whether his selection has been a judicious one. The only positive consolation which the results of the laboratory tests will give is, that the selected material of good reputation is normal for its kind and should perform properly.

* * *

Where has any one ever seen a thriving city with mud streets? None could continue to exist under such conditions. A parallel situation actually exists in the country.

* * *

It is wholly unnecessary for you to go home and hunt up the calendar to find out that this is March. Just look at the front cover of this issue or most of the roads in your locality.

*By Prevost Hubbard—Proc. Am. Road Builders Association. P. 213-216.
*See also Eng. News, June 8, 1911. P. 680-683.

## Kentucky

SHORT COURSE IN HIGHWAY ENGINEERING.

THE annual school of those interested in Public Highways opened at State University in Lexington at two p.m. on Monday, February 7 with quite a substantial attendance. By the middle of the week 160 had registered for this course with a continued increase in attendance each day.

Quite a large exhibit of road machinery was placed in front of the building by various manufacturing concerns who had representatives in attendance.

Since the establishment of this course in Highway engineering the attendance has steadily increased from year to year and the Faculty of the Civil Engineering Department is highly pleased with the results of their efforts. Not only the County Road Engineers attend, but county judges and magistrates of the fiscal court, State inspectors, and others are on hand, to obtain the valuable information which is here disseminated. The program is made up of speakers who are experts on the various subjects that are discussed, and one of the best features of the work is the general discussion that follows the leading speaker on any subject. This gives all an opportunity to ask questions and clear up obscure points in their own minds.

The regular examination of those who desire to receive appointment as County Road Engineers of the various counties of the State was held in the office of the Commissioner of Public Roads immediately following this short course. Those who have attended the short course found that the instruction received there was a great benefit to them in solving the problems of the examination given by the State Road Commissioner. This short course in Highway Engineering is of more value as a means of preparation for aspirants to this position than any other agency in Kentucky.

COUNTY ROAD ENGINEERS CONVENTION.

The annual convention of the County Road Engineers of Kentucky was held at the Phoenix Hotel in Lexington on February 4 and 5. There were about seventy-five members in attendance. New proposed road legislation was discussed, together with many interesting features of road building. The following program was rendered:

President Jacob Strous presiding.

Address of Welcome—Jas. C. Rogers, Mayor of Lexington.

Response on behalf of County Road Engineers, J. Russell Gaines, County Road Engineer, Jefferson County.

Convict Labor on Public Roads—Col. R. J. McBryde, President Kentucky Good Roads Association, Louisville, Kentucky.

Cost of Concrete Road Construction—O. M. Clark, Indianapolis, Indiana.

*Afternoon Session.*

Maintaining of Macadam Roads—C. S. Woodard, County Road Engineer, Jessamine County.

What Kentucky is Doing in Road Building—Robert C. Terrell, Commissioner of Public Roads, Frankfort, Kentucky.

Practical Economy in Road Building—W. H. Edwards, Jr., County Road Engineer, Woodford County.

Efficiency in Handling Road Materials—R. W. Davis, County Road Engineer, Fayette County.

On Friday night the delegates were entertained by the Lexington Commercial Club.

Saturday—President Jacob Strous presiding.

Financing a system of Public Roads—F. A. Bullock, Judge Fayette County Fiscal Court.

What West Virginia is Doing in Road Construction—A. D. Williams, Chief Engineer, State of West Virginia.

Mountain Roads—F. McClure, Engineer in charge of construction in Knox County.

Cost of Bituminous Roads—J. E. Boltz, Judge of Campbell County Court.

Report of Committees.

Before adjournment the body passed the following resolutions:

"We, the Committee on Nominations, recommend the following officers for the ensuing year:

W. H. Edwards, President; Wm. P. Caldwell, First Vice-President; Clinton Woodard, Second Vice-President; R. W. Davis, Third Vice-President.

Executive Committee—R. C. Terrell, Ex-Officio Chairman; Wm. Edwards, Chairman; Russell Gaines; Jacob Strous; B. F. Bacon; Thos. Hubbard.

Signed,
Ed. Butler, Chairman,
Thos. Hubbard,
R. W. Davis,
Committee."

"The Committee on Legislation beg to make the following report:

"That it is the sense of this Committee that our desires be communicated to the Legislature of our State as follows:

"That we, an organization of County Road Engineers of the State of Kentucky, in Convention assembled at Lexington this fourth and fifth day of February, 1916, do hereby petition the State Legislature, now in session at Frankfort, that we believe the best interest of the public will be furthered by the passage and solicit their especial consideration of the following bills:

"Senate Bill 100, known as the State-aid for improving through roads; Senate Bill 104, relative to working convict labor; Senate Bill 157, known as the Wide Tire Bill; Senate Bill 201, relative to guarantee of metal products; House Bill 33, enabling Fiscal Courts to borrow money; House Bill 106, relative to weed cutting on public highways; House Bill 214, relative to Constitutional Amendments, as has been reported by the Committee.

Signed,
W. H. Edwards, Jr.,
R. W. Davis,
C. S. Woodard,
M. C. Champion,
B. F. Bacon."

"We the Committee on Resolutions, appointed by the County Road Engineers Association of Kentucky, respectfully report the following resolutions: be it

*Resolved*, That a vote of thanks be tendered the Press Association of the city of Lexington, and Mayor Rogers, for the hearty welcome tendered this body. That the management of the Phoenix Hotel be tendered a vote of thanks for the courtesy shown us in the use of this hall. That the various machinery and material men be tendered our thanks for the expense, courtesy, and liberality showered on us in their capable and splendid entertaining of this convention. That the Legislative Committee be respectfully urged to use its best endeavors to have Legislation enacted to improve road construction, be it further

*Resolved*, That this body by a standing vote, show its appreciation of the good work, hearty co-operation and splendid results, attained by the Commissioner of Public Roads and his able assistants.

Signed,
C. S. Woodard,
J. Edw. Boltz,
W. G. Cundiff,
Committee.

* * *

## Michigan

### Outlook for Road Building in Michigan for 1916

By Frank F. Rogers, State Highway Commissioner

MICHIGAN has approximately 70,000 miles of public wagon roads outside the corporate limits of villages and cities. These roads necessarily carry a varying traffic ranging from approximately 3,000 vehicles per day down to roads which do not even see a single vehicle on certain days. The roads not being of equal importance from a traffic standpoint, and over soils ranging from the hardest clays to dune sands require widely different kinds of improvement. But when we thing of the road problem of any State we do not expect that all of the roads will ever be substantially improved. Some of them would be quite satisfactory if well drained and improved as earth roads, or if on sandy soils, given some covering of clay or such other material as might harden the surface.

But since it is estimated that one-tenth of the road mileage of any State accommodates fully 80 per cent. of the traffic it

will be seen that from 7,000 to 10,000 miles of the main highways carefully selected and improved would practically solve Michigan's road problem. In fact Michigan has less than 10,000 miles of railroads including the interurban electrics and they reach almost every town in the State. Hence we have estimated that if we can improve in a substantial way, some 15,000 miles of the main highways, we shall reach every city, village, hamlet, and railway station on all of the main roads which approach them.

Michigan began to improve its roads with State aid in July, 1905. Since that time the miles of State reward roads completed by years are as follows:

| | |
|---|---|
| 1905 | 18.0 |
| 1906 | 64.25 |
| 1907 | 96.5 |
| 1908 | 161.0 |
| 1909 | 204.5 |
| 1910 | 304.25 |
| 1911 | 382.75 |
| 1912 | 523.0 |
| 1913 | 696.25 |
| 1914 | 757.34 |

Between July 1, 1915, and December 1, 1915, 884 miles of roads were completed, making a total of 4,082 miles to date.

Thus it will be seen from the foregoing that by the close of the present fiscal year, June 30, there will have been completed for State reward in Michigan fully 4,200 miles of highways. These highways, for the most part are located on the main lines of roads reaching out from the various market places of the State, but have not extended far enough to become connected at the ends, but the building of some 10,000 miles more of properly located highways will connect up the roads already built and give to Michigan a system of highways which will not only reach all the market places, but which will make continuous lines of roads from town to town all over the State, which may be traveled with ease and comfort every day in the year.

From the above table showing the progress in miles of improved roads during the last ten years, it is apparent that fully one-third of the roads improved have been built during the last two years and that the State is now fast approaching the time when fully 1,000 miles of first-class roads will be built annually. That being true ten years or less should see the main roads improved in the manner already described, and the dreams of the good roads boosters of our State will have been realized.

But future progress will depend largely on the State's ability to meet its portion of the cost. Already the counties and townships are willing to build more than roads enough to take the State appropriations, the growth of which has been phenomenal. See table of road taxes since 1905:

MICHIGAN'S ROAD TAXES 1905-1916.

| Year | Township Road Tax | County Road Tax | State Reward Tax | Total |
|---|---|---|---|---|
| 1905 | $ 2,976,077.47 | $ 285,963.80 | $ 30,000 | $ 3,292,041.27 |
| 1906 | 2,988,989.17 | 420,321.10 | 60,000 | 3,469,310.27 |
| 1907 | 3,091,647.59 | 421,307.07 | 110,000 | 3,622,954.66 |
| 1908 | 2,916,817.01 | 529,452.45 | 160,000 | 3,606,269.46 |
| 1909 | 3,014,344.94 | 741,868.05 | 150,000 | 3,006,212.99 |
| 1910 | 3,264,049.30 | 859,157.50 | 150,000 | 4,273,206.80 |
| 1911 | 3,448,309.37 | 815,227.24 | 245,000 | 4,508,536.61 |
| 1912 | 3,845,834.89 | 1,308,043.13 | 245,000 | 5,398,878.02 |
| 1913 | 4,336,029.59 | 1,621,681.04 | 800,000 | 6,757,710.63 |
| 1914 | 4,647,016.86 | 1,882,728.88 | 320,000 | 6,849,745.74 |
| | | | *600,000 | |
| 1915 | 5,714,837.81 | 2,474,771.26 | 975,000 | 9,764,609.07 |
| 1916 | | | 580,000 | 580,000.00 |
| | | | +800,000 | 800,000.00 |
| Total | $40,243,954.00 | $11,360,521.52 | $5,225,000 | $56,829,475.52 |

* Deficiency Appropriation.
\+ Auto Tax Est.

What the State is able to do in 1916 is problematical. It is estimated that the taxes from the new auto law will be upwards of one and one-half millions of dollars, only one-half of which is to be credited to the State, to be distributed by the State Highway Department, the other half being returned to the counties from which it is received, but all to be used for the building or maintenance of highways. But the new auto tax law is now before the courts to test its constitutionality and the outcome is uncertain. Should the law again be declared unconstutitional, road building in Michigan will receive a severe blow. There would still remain, however, in the trunk line appropriation, $550,000, which must be used for paying one-half of the rewards due on the trunk lines, building trunk line bridges, making trunk line surveys, etc. In addition to the above there is an appropriation of $30,000 for general departmental expenses.

On the other hand should the Auto Tax Law be sustained, the State will have for road purposes during the fiscal year 1916-17 approximately $1,380,000, which should pay the State rewards on fully 1,000 miles of new highways and build fifteen or twenty trunk line bridges. But should the Auto Tax money be lost, it seems to the writer that a one-half mill State highway tax, which on the present State valuation would yield $1,400,000 should be enacted by the next Legislature, and the State's portion of road improvement should be kept within the appropriation.

* * *

## Tabulated Statement

The Tabulated Statement below shows the total square yards of the important types of pavements laid in 1914 and 1915. Each total was obtained from detailed information recorded in the Municipal Journals of Feb. 4, 1914, and Feb. 5, 1915, and the data is reported by that Journal to represent about 90 per cent. of all paving done in the United States.

The statement also shows the totals of the yardage for those two years, in Ohio, Michigan, New York City, New York State, Illinois, Indiana and Pennsylvania.

The table was prepared by F. W. Patterson of the Cleveland-Trinidad Paving Co., of Cleveland, Ohio.

| Types of pavement | Year 1914 | Year 1915 |
|---|---|---|
| Sheet Asphalt | 7,834,187 sq. yds. | 9,928,714 sq. yds. |
| Bitulithic | 3,218,943 sq. yds. | 3,519,542 sq. yds. |
| Bituminous Concrete | 3,302,721 sq. yds. | 4,956,892 sq. yds. |
| Asphalt Block | 450,421 sq. yds. | 731,676 sq. yds. |
| Brick | 6,392,559 sq. yds. | 6,078,469 sq. yds. |
| Wood Block | 1,722,720 sq. yds. | 1,093,435 sq. yds. |
| Concrete | 4,460,302 sq. yds. | 5,606,799 sq. yds. |
| Concrete, Bituminous top | 933,212 sq. yds. | 1,057,016 sq. yds. |
| **Laid in Ohio only in the above years.** | | |
| Sheet Asphalt | 278,743 sq. yds. | 459,427 sq. yds. |
| Bitulithic | 2,081 sq. yds. | 49,244 sq. yds. |
| Bituminous Concrete | 120,808 sq. yds. | 232,816 sq. yds. |
| Asphalt Block | 36,658 sq. yds. | 132,168 sq. yds. |
| Brick | 1,825,179 sq. yds. | 1,643,801 sq. yds. |
| Wood Block | 76,310 sq. yds. | 114,310 sq. yds. |
| Concrete | 104,614 sq. yds. | 199,895 sq. yds. |
| Concrete, Bituminous top | 23,795 sq. yds. | 9,800 sq. yds. |
| **Laid in Michigan only in the above years.** | | |
| Sheet Asphalt | 259,750 sq. yds. | 216,303 sq. yds. |
| Bitulithic | ..... sq. yds. | 11,407 sq. yds. |
| Bituminous Concrete | 298,387 sq. yds. | 725,133 sq. yds. |
| Concrete | 303,471 sq. yds. | 364,035 sq. yds. |
| Concrete, Bituminous top | 13,270 sq. yds. | 9,817 sq. yds. |
| Brick | 189,784 sq. yds. | 359,940 sq. yds. |
| Wood Block | 124,390 sq. yds. | 31,360 sq. yds. |
| **Laid in Illinois in the above years.** | | |
| Sheet Asphalt | 932,855 sq. yds. | 914,300 sq. yds. |
| Asphalt Block | ..... sq. yds. | ..... sq. yds. |
| Bitulithic | ..... sq. yds. | ..... sq. yds, |
| Bituminous Concrete | 546,269 sq. yds. | 458,864 sq. yds. |
| Brick | 1,399,575 sq. yds. | 827,900 sq. yds. |
| Concrete | 591,479 sq. yds. | 258,456 sq. yds. |
| Wood Block | 153,332 sq. yds. | 103,880 sq. yds. |
| Concrete, Bituminous top | 39,932 sq. yds. | 130,000 sq. yds. |
| Granite Block | 45,475 sq. yds. | 52,500 sq. yds. |
| **Laid in Indiana in the above years.** | | |
| Sheet Asphalt | 149,005 sq. yds. | 696,731 sq. yds. |
| Bitulithic | ..... sq. yds. | ..... sq. yds. |
| Bituminous Concrete | 99,834 sq. yds. | 108,280 sq. yds. |
| Asphalt Block | ..... sq. yds. | ..... sq. yds. |
| Brick | 189,906 sq. yds. | 333,000 sq. yds. |
| Wood Block | 612 sq. yds. | 3,115 sq. yds. |
| Concrete | 213,842 sq. yds. | 373,762 sq. yds. |
| Concrete, Bituminous top | 10,791 sq. yds. | ..... sq. yds. |
| **Laid in New York State in the above years** | | |
| Sheet Asphalt | 1,435,333 sq. yds. | 1,194,024 sq. yds. |
| Bituminous Concrete | 286,299 sq. yds. | 211,608 sq. yds. |
| Bitulithic | 164,369 sq. yds. | 194,646 sq. yds. |
| Asphalt Block | 220,193 sq. yds. | 242,059 sq. yds. |
| Brick | 632,235 sq. yds. | 442,484 sq. yds. |
| Granite Block | 623,859 sq. yds. | 358,268 sq. yds. |
| Wood Block | 179,238 sq. yds. | 15,625 sq. yds. |
| Concrete | 168,363 sq. yds. | 211,535 sq. yds. |
| **Laid in Pennsylvania in the above years.** | | |
| Sheet Asphalt | 706,544 sq. yds. | 585,852 sq. yds. |
| Bituminous Concrete | 297,980 sq. yds. | 98,897 sq. yds. |
| Bituminous Macadam | 55,579 sq. yds. | 224,290 sq. yds. |
| Bitulithic | 18,549 sq. yds. | 53,726 sq. yds. |
| Asphaltic Block | ..... sq. yds. | 44,128 sq. yds. |
| Brick | 515,384 sq. yds. | 634,563 sq. yds. |
| Wood Block | 54,815 sq. yds. | 78,399 sq. yds. |
| Concrete | 72,237 sq. yds. | 40,384 sq. yds. |
| Concrete, Bituminous top | 830 sq. yds. | ..... sq. yds. |

Respectfully submitted,
F. W. PATTERSON.

The compilation below will show the increase or decrease of square yards, of different types of pavement, laid in 1914 or 1915; the amount of yardage is deduced from a tabulated statement (of which this is a supplement) compiled from data published in the Municipal Journals of Feb. 4, 1914, and Feb. 3, 1915.

### UNITED STATES.

**Sheet Asphalt, Bitulithic, Bituminous.**

During the year 1915, there were laid 4,049,397 square yards more than in 1914.

*February 8, 1916—It was sustained by the Circuit Court of Wayne County.

**Asphalt Block.**
281,255 square yards more were laid in 1915 than in 1914.
**Brick.**
During 1915, the total square yards laid were 314,130 less than in 1914.
**Concrete, Concrete (Bituminous top).**
1,270,301 square yards more were laid in 1915 than in 1914.
**Wood Block.**
629,285 square yards more were laid in 1914 than in 1915.

### OHIO.

**Sheet Asphalt, Bitulithic, Bituminous.**
During the year 1915 there were laid 329,855 square yards more than during the year 1914.
**Asphalt Block.**
95,510 square yards more were laid in 1915 than 1914.
**Brick.**
During the year 1915, there were laid 181,378 square yards less than during the year 1914.
**Wood Block.**
38,000 square yards more were laid during 1915 than 1914.
**Concrete, Concrete (Bituminous top).**
81,286 square yards more were laid during 1915 than 1914.

### MICHIGAN.

**Sheet Asphalt, Bitulithic, Bituminous Concrete.**
During the year 1915 there were laid 394,706 square yards more than in 1914.
**Brick.**
During the year 1915 there were laid 170,156 square yards more than in 1914.
**Concrete, Concrete (Bituminous top).**
57,111 square yards more were laid during the year 1915 than in 1914.
**Wood Block.**
93,083 square yards more were laid during the year 1914 than in 1915.

### ILLINOIS.

**Sheet Asphalt, Bituminous Concrete.**
115,960 square yards more were laid during the year 1914 than in 1915.
**Concrete.**
233,023 square yards more were laid during 1914 than in 1915.
**Brick.**
511,675 square yards less were laid during the year 1915 than in 1914.
**Concrete, Bituminous top.**
90,068 square yards more were laid during the year 1915 than in 1914.
**Wood Block.**
49,532 square yards more were laid during the year 1914 than in 1915.

### INDIANA.

**Sheet Asphalt, Bituminous Concrete.**
556,172 square yards more were laid during the year 1915 than in 1914.
**Brick.**
143,094 square yards more were laid during the year 1915 than in 1914.
**Concrete.**
149,129 square yards more were laid during the year 1915 than in 1914.

### NEW YORK STATE.

**Sheet Asphalt, Bitulithic, Bituminous.**
During the year 1914 there were laid 285.723 square yards more than during 1915.
**Brick.**
During the year 1915, there were laid 189,851 square yards less than during 1914.
**Asphalt Block.**
21,866 square yards more were laid during 1915 than 1914.
**Granite Block.**
265,591 square yards more were laid during 1914 than 1915.
**Wood Block.**
63,613 square yards more were laid during the year 1914 than 1915.
**Concrete.**
43,172 square yards more were laid during the year 1915 than 1914.

* * *

## Street Cleaning in Milwaukee

### The Use of New and Improved Machinery and Scientific Methods Effects Big Economies, says Bureau of Municipal Research

MOST complete and detailed data on the cost of practically all methods of street cleaning have recently been compiled by the Bureau of Municipal Research of Milwaukee, Wisconsin. Under the competant direction of Prof. John C. Davis, of Marquette College, Director, and William H. Yox, Assistant Director, the studies in municipal economy being carried on by this Bureau, are of the most comprehensive sort and worthy of careful consideration.

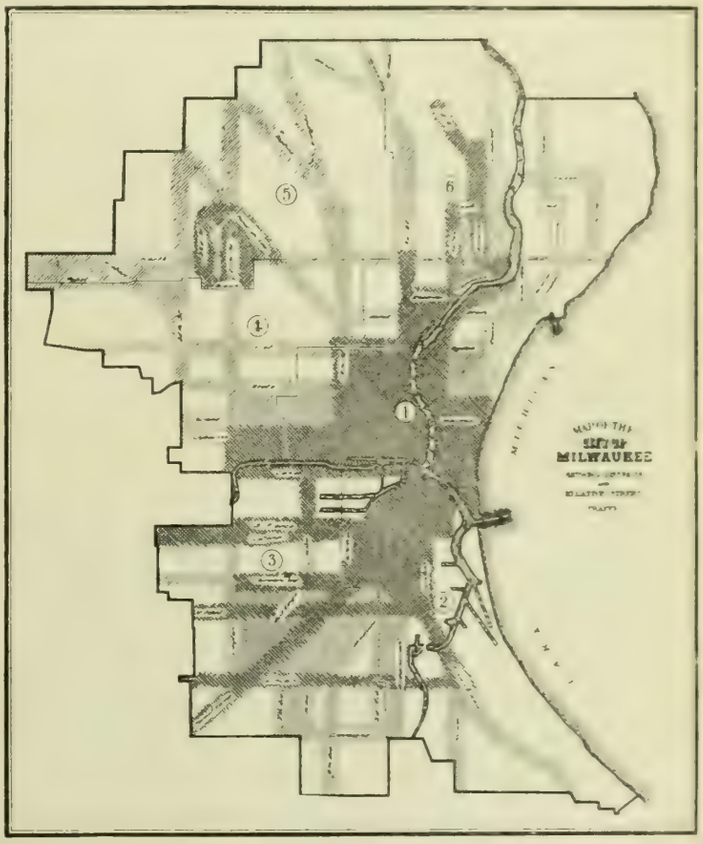
The street cleaning department of Milwaukee is confronted with the problem of maintaining sanitary conditions on 550 miles of streets distributed over 25.72 square miles of territory. The amount of the various types of pavement are as follows:

| | Miles | Per Cent. |
|---|---|---|
| Cedar Block | .5 | .1 |
| Creosoted Wood Block | 8.0 | 1.5 |
| Stone Block | 19.0 | 3.4 |
| Brick | 25.0 | 4.5 |
| Asphalt | 82.0 | 14.9 |
| Macadam | 200.0 | 36.4 |
| Unimproved | 215.5 | 39.2 |
| Total | 550.0 | 100.0 |

SQUARE YARDS OF PAVEMENT BY DISTRICTS.

| Type of Pavement | DISTRICTS 1 | 2 | 3 | 4 | 5 | 6 | Total Yardage |
|---|---|---|---|---|---|---|---|
| Asphalt | 540,361 | 126,096 | 275,151 | 162,119 | 268,736 | 227,707 | 1,600,170 |
| Brick | 213,292 | 218,706 | 96,383 | 29,592 | 29,425 | 86,610 | 674,008 |
| Macadam | 420,231 | 770,610 | 790,860 | 960,019 | 1,037,894 | 762,430 | 4,742,044 |
| Granite | 74,448 | 881,957 | 34,333 | | | 45,417 | 236,255 |
| Creosote | 27,765 | | | 18,768 | 1,947 | 25,473 | 73,953 |
| Cedar | 1,166 | | | 8,685 | 9,959 | 8,112 | 27,922 |
| Mullen's Mix | 10,807 | 73,775 | 36,550 | 161,402 | 83,707 | 49,715 | 418,756 |
| Limestone | 1,920 | 27,757 | | | | 4,840 | 34,517 |
| Sandstone | 43,024 | 13,514 | 1,422 | 6,523 | | 104,408 | 168,891 |
| Unimproved | 104,318 | 548,322 | 292,837 | 52,757 | 373,130 | 54,036 | 1,425,400 |
| Total | 1,437,332 | 1,860,737 | 1,527,536 | 1,402,865 | 1,804,198 | 1,368,577 | 9,401,246 |

The following map shows the boundaries of the district given in the above table and the relative density of traffic in various parts of the city.




The methods of street cleaning in force at the present time are as follows:

In congested districts the thoroughfares are flushed nightly and patrolled by white wings during the day. In manufacturing and commission brokerage districts, rotary brooms are operated at night, with white wing patrol and sprinkler service daily. Upon boulevards and smooth surface pavement squeegees are operated from one to two times weekly; and upon streets with car tracks the flushers are used once weekly. In residential districts sprinklers operate twice daily with weekly rotary broom cleaning. In sections recently annexed, hoe cleaning is done when necessary.

The source of dirt, dust and litter is attributed to the following causes:

1. ABRASION OF STREET SURFACE.
Methods of construction
Narrow vehicle tires
Impact of the equine hoof
Compression of loaded drays
Shearing by rapid transit

2. DIRT CARRIED ON TO STREETS.
Contractors' wagons.
Farm and truck wagons
Dry sweeping of walks
Emptying receptacles in gutters
Cleaning cuspidors, etc.

3. EXCREMENT OF ANIMALS.
Inefficient methods to remove

4. DECAY OF LEAVES AND TWIGS.

5. DISTRIBUTION OF LITERATURE, ETC.

6. INEFFICIENCY OF EMPLOYES.
Lack of supervision
Lack of system
Lack of able-bodied men
In the words of the recent report:

"The majority of taxpayers' money appropriated to the Bureau of Street Sanitation is expended in keeping thoroughfares in a sanitary and presentable appearance, and much of this sum can be squandered by incompetent executives. It requires more ingenuity on the part of a Supervisor of Street Cleaning to properly conduct his activities than on any other branch of municipal work, and the department must exercise every precaution in selecting men to perform this difficult task. The entire success of the work, however, does not wholly depend upon the executive but considerably upon the nature of equipment employed. An expert cannot do justice to his work if he does not possess the necessary equipment to aid him, and the Bureau of Municipal Research is cognizant of the fact, and wishes to impress citizens by this report that economy can be practiced if the Department of Street Sanitation is no longer hampered by objection to the employ of modern methods.

"Each phase of Street Sanitation has been an object of attentive consideration and all irregularities studied with a view for betterment.

The functions of this class of work are:
Squeegee cleaning
Flusher cleaning
Sprinkling of streets
Rotary broom service
Pick-up sweeper service

and each are treated separately, showing the system inaugurated by the Research Bureau and the present cost of operation."

Following is a general description of each method of street cleaning employed in the city or investigated elsewhere by the Bureau.

SQUEEGEE CLEANING.

Ten Kindling squeegee machines are in constant operation by the Bureau of Street Cleaning upon smooth surfaced pavements. Where streets are exceptionally wide, three machines are used in staggard formation, which necessitates but one and one-half complete trips over a street to perfect the cleaning. They are routed in such a manner that little idle travel is necessary and filling plugs are specified to prevent empty travel to any extent.

The same system is applied to territories where only two machines can be operated except that four return trips are necessary to complete the work. Operators are not allowed to confine their work to a given block, unless conditions make it necessary, but must continue on until tanks are emptied, which usually occurs at the end of two blocks. Two laborers follow these machines to keep the gutters free from dirt and perform other services. The work of the squeegees is very efficient and the cost of operation economical.

During 1914 (prior to the re-organization of ward work) the equipment was operated under the supervision of ward superintendents and restricted to the wards to which they were assigned. In some instances, however, the Superintendent of Street Sanitation would transfer machines from one ward to another for indefinite use; but in all cases the unit costs were high, due to lack of supervision and systematic operation.

COST OF SQUEEGEE OPERATION.

1914.

| | | |
|---|---|---|
| Fixed charges | | |
| Depreciation and repairs at 10% on $1,110 (cost of machine only) | $111.00 | |
| Depreciation and repairs at 50% on $140 (roller only) | 70.00 | |
| Interest at 4½% on $1,250 (total cost) | 56.25 | $237.25 |
| Maintenance | | |
| Painting (each season) | 20.00 | |
| Hose and couplings (each season) | 15.00 | 35.00 |
| Total season cost | | $272.25 |
| Cost per day (150-day season) | | 1.815 |
| Operation | | |
| Team hire, per day | 5.00 | |
| One sweeper at $2.00 per day | 2.00 | |
| Water at 6c per 1,000 gal | .82 | 7.820 |
| Total cost per machine per day | | 9.635 |

UNITS COSTS.

1914

| SECTION | Number of Machines Used | Yardage Cleaned Per Day | Cost per 1000 Square Yards (Cents) | Assessment per Front Foot, 30-foot Street Cleaned 50 Times per Season (Cents) |
|---|---|---|---|---|
| Northeast | 2 | 44,512 | 43.3 | 3.59 |
| East | 2 | 46,958 | 41.0 | 3.40 |
| North | 2 | 34,530 | 55.8 | 4.63 |
| South | 1 | 37,683 | 25.5 | 2.11 |
| West | 2 | 52,550 | 36.7 | 3.04 |
| Central | 2 | 46,062 | 41.8 | 3.47 |
| 1915 | | | | |
| East | 3 | 113,301 | 25.5 | 2.11 |
| Northwest | 2 | 76,366 | 25.2 | 2.09 |
| South | 2 | 87,332 | 22.0 | 1.82 |
| Central | 3 | 100,713 | 28.7 | 2.38 |

The greatly lessened unit cost in 1915 was due to a ward re-organization, the supervision of squeegees being vested in a Supervisor of Street Flushing who operated at the same cost per machine as the preceeding year, but cleaned a greatly increased area per day by following routes laid out and platted by the Bureau of Municipal Research.

During the year 1914, under the old ward system, the average area cleaned daily was 262,295 square yards at a cost of $86.71 per day, or a unit cost of 33.2c per 1,000 square yards.

Since the inception of the new system inaugurated by the Bureau the average area cleaned daily is 377,712 square yards, an increase of 115,417 square yards over the preceding year. This necessitates a daily expenditure of $96.35, being an increase of only $9.64 over the cost of operation during 1914. The unit cost of operation for the present system is 25.5c per 1,000 square yards, representing a reduction of 7.7c.

If the increased area had been cleaned during the year 1914 at the then prevailing unit cost, it would have necessitated a daily expenditure of $125.40, an excess of $29.05 over the cost for 1915. This represents an increase in efficiency worth $4,357.50.

The fact that this process of cleaning is assessable means that the property owners along the route of the 1914 system are being extended better service at a reduced assessment, while those abutting the new routes are receiving the service sought by them at a cost per front foot, less than the amount assessed for 1914.

Of the total yardage of pavement in the city, 1,105,324 square yards are free from car tracks and subject to the squeegee process. Some of the thoroughfares are "squeegeed" twice weekly, while others are cleaned but once, and each have the additional service of white wings and sprinklers.

The Bureau is of the opinion that the thoroughfares are not sufficiently cleaned, that the sprinkling is of no benefit, that dry sweeping is insanitary; and that by the purchase of more equipment the cleaning could be done daily in the congested districts, three times weekly where semi-weekly cleaning is

performed, and twice weekly where the streets are cleaned occasionally.

MOTOR DRIVEN SQUEEGEE.

The Sterling Motor Truck Company, Milwaukee, Wisconsin, will place on the market this year a motor driven squeegee which promises to be of particularly efficient and economical service. In 1915 the Kindling Machinery Company, Milwaukee, owner of the squeegee patent and manufacturer of the horse-drawn machine, had a demonstration motor squeegee built by Pawling & Harnishfeger, Milwaukee, using a motor of the Kissel Motor Car Company, Hartford, Wisconsin. The successful use of this machine in Milwaukee during the summer and fall of 1915 led to the arrangement between the Kindling Company and the Sterling Motor Truck Company of the latter to manufacture motor driven squeegees on a commercial scale. A description of the new Kindling-Sterling machine is found elsewhere in this issue.

The capacity of the tank of the trial machine was 750 gallons—200 more than that of the horse-drawn machine. This



**The Demonstrator Motor Squeegee**

allowed greater areas to be cleaned between fillings, reducing the lost time at hydrants.

There are two sets of sprays, one directly in front of the machine and the other in front of the squeegee. Back of the first spray is a set of two brushes used to loosen any hardened matter that might not be removed by the squeegee process alone.

With this machine it was found unnecessary to employ laborers to keep the gutters clean, as the discharge of water was sufficient to remove slight obstacles that are not removed by the horse drawn equipment.

It is the suggestion of the Bureau that the tanks of all new motor squeegees be made removable and another body provided, thus rendering the machine available for other purposes, such as hauling ashes, when desired. Assuming that this feature will be provided in new machines, in the following table only one-half of the fixed charges and cost of maintenance are charged to street cleaning:

COST OF MOTOR SQUEEGEE OPERATION.

| | | |
|---|---|---|
| Fixed charges | | |
| Depreciation and repairs at 25% on $3,850 (machine only) | $962.50 | |
| One-half chargeable to street cleaning | $481.25 | |
| Interest on investment at 4½% on $4,000 | 180.00 | |
| One-half chargeable to street cleaning | 90.00 | |
| One roller per season | 85.00 | $656.25 |
| Maintenance | | |
| Hose and couplings | 15.00 | |
| Depreciation at 50% on four tires at $52.50, 50% of $210.00 | $105.00 | |
| One-half chargeable to street cleaning | 52.50 | |
| Replacement of two brushes at $1.00 each (once per season) | 2.00 | 69.50 |
| Total season cost | | $725.75 |
| Cost per day (150-day street cleaning season) | | 4.84 |
| Operation | | |
| One sweeper at $2.00 per day | 2.00 | |
| One chauffeur at $3.00 per day | 3.00 | |
| Basoline and oil per day | 1.82 | |
| Water at 6c per 1,000 gal | 1.60 | 8.42 |
| Total daily cost | | $ 13.26 |
| Average square yards cleaned per day | | 80,000 |
| Cost per 1,000 square yards | | 16.5c |
| The assessment per front foot based on a street 30 feet wide and cleaned 50 times per season would be | | 1.37c |

The two cost data tables show the operating expenses of the horse-drawn and motor-driven squeegees, and that the latter type will perform twice the amount of work of the former at a reduced unit cost.

A careful analysis of the traffic condition of the streets cleaned by squeegees shows that 1,105,324 square yards are subject to this process of cleaning and that from the total yardage the amount of 143,825 square yards should be cleaned 6 times, 308,133 square yards, should be cleaned 3 times, and 383,365 square yards should be cleaned 2 times each week, or a daily cleaning of approximately 700,000 square yards.

The average yardage covered per day by a horse-drawn squeegee being 35,000 square yards, it will require twenty machines, or an additional eight over the present equipment, to perform the work; but if the motor-driven type were substituted the purchase of only four machines would be necessary.

The difference in operating cost of the two types would be as follows:

Horse-drawn type, average cost per 1,000 square yards, 25.5c.

Motor-driven type, average cost per 1,000 square yards, 16.5c.

Reduction in cost per 1,000 square yards, 9c.

If the motor-driven squeegees were not available, the cost of operating the eight additional horse-drawn machines would be greatly in advance of the motor-driven type, as the following data shows:

8 machines x $9.635 cost per machine = $77.08 x 150 days = $11,562.00.

By operating these 8 machines it would eliminate the service of

| | |
|---|---|
| 9 white wings at $2.00 per day x 150 days | $2,700.00 |
| 8 sprinklers at $6.34 per day x 150 days | 7,608.00 |
| Total | $10,308.00 |
| *Twice weekly squeegee cleaning | 3,854.00 |
| Grand total | $14,262.00 |
| Less the cost of operating 8 squeegees | 11,562.00 |
| Effecting a season's saving of | $ 2,700.00 |

4 motor-driven machines x $13.26 cost per machine x 150 days = $7,956.00.

Saving over cost of operating 8 horse-drawn machines = $11,562.00—$7,956.00 or a saving of $3,606.00.

With the same services eliminated for the motor-driven as for the horse-drawn squeegee, the total saving would be

$14,262.00—$7,956.00=$6,306.00

*This item is included because certain streets are only cleaned twice a week that require the service six times weekly; and if performed the maximum number of times would eliminate the stipulated number of white wings and sprinklers.

FLUSHER CLEANING.

The Bureau of Street Cleaning operates eight Studebaker horse-drawn flushers, both day and night.

The night work is confined to two districts comprising the heavy traffic and commercial territories, and each alternating night the streets are flushed. This requires the use of four machines and they operate in a staggered double formation, cleaning the entire area without a return movement.

*(Continued in April Issue.)*

## Tells Western Society of Engineers about Intensive Street Cleaning Methods

THAT a piece of paper dropped on State Street, Chicago, will be removed by the street sweeper within 2.7 minutes on the average, was only one of the remarkable statements made by Richard T. Fox, General Manager of the Citizens' Street Cleaning Bureau of Chicago in his talk on "Intensive Street Cleaning Methods," before the Western Society of Engineers on February 7, 1915.

Mr. Fox's paper was a revelation, to the engineers assembled, of painstaking attention to detail, both in the layout of work for the street sweepers and of office tabulation and study which made the former possible. The numerous charts and diagrams thrown on the screen showed the most thorough scientific study of the problem of street cleaning in the down-town district of a great metropolis, which has been made by Mr. Fox during the last eleven years since the organization of the Citizens' Street Cleaning Bureau.

Briefly, the layout of the Bureau's street cleaning is as follows:

Each "white wing" is assigned a certain section, averaging about 3,000 square yards in extent—between one and two city blocks. It is the duty of the sweeper to go over this entire area once every fifteen minutes, sweeping up all dirt and refuse. He does not sweep the entire area of the street or attempt to remove the fine dust, merely taking up the coarse dirt *before it is scattered and trampled down into the pavement.* The fine dust is removed at night by means of motor-driven flushers.

The effectiveness of this system in keeping the streets clean *at all times* is shown by the following tabulation, which compares the Chicago and New York methods on streets of similar nature.

| | Square Yards Cleaned per Man | Times Cleaned Per Day | Cubic Yards of Dirt Removed per year per 1000 Sq. Yards Pavement |
|---|---|---|---|
| New York | 3,250 | 5 or 6 | 56 |
| Chicago | 3,000 | 56 | 80 |

The work required of the men is about equal in the two cities for, while the Chicago street sweeper has more walking to do than the New York white wing, he has much less work to do with his arms, inasmuch as the New York man has to sweep the entire pavement on each trip to remove all of the *scattered* refuse which has accumulated in the two hours elapsing between trips. Only fifteen minutes or less elapses between trips of the Chicago sweeper, so the dirt is not scattered and occurs only in relatively few patches along the route.

It is readily seen that the great advantage of the Chicago method over that of New York lies in the fact that any given



Fig. 1. Weighing Refuse

area of Chicago streets (inside the Bureau's district) is kept clean a large percentage of the time (67%), while a like area of New York's streets is probably not entirely clean at any time.

The following table shows the percentage of total pick-ups made within one, two, three, etc., minutes after the refuse was deposited on the street; also the number of minutes in each hour that the street was free from refuse. It is seen in the last column that some routes show more and some less than forty minutes per hour. The average is close to forty, which gives the figure 67% quoted above.

TABLE I.

SHOWING PERCENTAGE OF TOTAL DAILY PICK-UPS MADE IN THE MINUTES INDICATED AND THE LENGTH OF TIME STREET WAS FREE OF REFUSE—IN A TEST OF ONE DAY.

| No. of Route | Minutes | | | | | | | | Time Street was free of Refuse Average Minutes per Hour |
|---|---|---|---|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 15th | |
| | % | % | % | % | % | % | % | % | |
| 3 | 35 | 60 | 71 | 78 | 80 | 86 | 92 | 100 | 40 |
| 5 | 34 | 63 | 72 | 82 | 85 | 89 | 91 | 100 | 36 |
| 6 | 39 | 62 | 77 | 81 | 83 | 93 | 94 | 100 | 38 |
| 12 | 35 | 58 | 70 | 78 | 85 | 88 | 89 | 100 | 21 |
| 19 | 32 | 50 | 63 | 76 | 82 | 84 | 85 | 100 | 33 |
| 20 | 58 | 81 | 90 | 92 | 95 | 99 | 100 | | 43 |
| 36 | 33 | 56 | 65 | 76 | 85 | 90 | 93 | 100 | 42 |

The first question taken up by Mr. Fox is his paper referred to standards of street cleaning, that is, what is a clean street? It was pointed out that traffic and other conditions vary so much in different cities and in different parts of the same city that it's difficult to define a standard of cleanliness.



Fig. 2. Flusher, designed by Citizens' Street Cleaning Bureau of Chicago, mounted on Saurer chassis

However, the above table illustrates a means of comparison adaptable to all streets where hand cleaning is used. In other words, the percentage of pick-ups made within various times and the number of minutes in an hour that a street is free of refuse, give a definite measure for comparing the cleanliness of two streets.

In making their comprehensive studies of street cleaning, the Citizens' Street Cleaning Bureau has weighed the refuse collected from known areas in a given time, weighed and analyzed chemically the fine dust, and carried on countless other practical investigations of a similar nature, the results of which are all tabulated in various ways, with the object of further perfecting the service.

One of the interesting points brought out by this mass of data is that, on a street carrying car tracks, the section around the tracks produces a far larger amount of fine dust (distinct from coarse dirt) than the roadways on either side, or the sidewalks. Chemical analysis show the fine dust from the car tracks to be largely silica, thus proving that it comes from an excess of sand used by the street car company on the rails.

The following tables illustrate this point:

TABLE I.

SHOWING CHEMICAL COMPOSITION OF STREET DUST.

| | Sidewalk Lbs. per 1000 Sq. Yd. Dust | Roadway, Curbs to Car Tracks Lbs. per 1000 Sq. Yd. Dust | Street Car Right of Way Lbs. per 1000 Sq. Yd. Dust |
|---|---|---|---|
| Silica | 0.96 | 4.70 | 50.50 |
| Carbon and Organic Matter | 0.67 | 3.00 | 26.00 |
| Calcium Carbonate | 0.20 | 0.60 | 6.00 |
| Magnesium Carbonate | 0.02 | 0.30 | 2.30 |
| Iron | 0.11 | 0.25 | 3.00 |
| Undetermined | .04 | 0.15 | 0.20 |
| Total | 2.00 | 9.00 | 88.00 |

TABLE III.

COMPARING AMOUNT OF FINE DUST COLLECTED ON TWO ADJACENT BLOCKS OF LASALLE STREET, ONE WITH CAR TRACKS AND ONE WITHOUT.

| | Sidewalk Lbs. per 1000 Sq. Yd. Dust | Roadway, Curbs to Car Tracks Lbs. per 1000 Sq. Yd. Dust | Street Car Right of Way Lbs per 1000 Sq. Yd. Dust |
|---|---|---|---|
| Street with car tracks | 4.30 | 6.00 | 90.00 |
| Strets without car tracks | 4.00 | 9.60 | 2.60 |

Largely because the street cleaning work of the Bureau is confined solely to the down-town heavily travelled streets, the only mechanical street cleaning device operated is a motor flusher. This is shown in Fig. 2, the flushing apparatus being designed by the Bureau and mounted on a Saurer chassis.

As before stated, the flusher operates at night and flushes thoroughly all of the streets under the jurisdiction of the Bureau, while weather permits. In the daytime it is used as a sprinkler.

The deep impression made by Mr. Fox's talk was reflected in a most interesting general discussion which followed.

* * *

## Snow Removal by Contract in New York City

By George D. Steele

IN the February issue of Better Roads and Streets, snow removal by "Snow Fighting" in New York City was taken up, methods and instructions to the snow fighting force having been published in detail. This month the removal of snow under the contract system is taken up, this really being the main method of snow removal, as the snow fighting by the city forces is merely an adjunct to assist the contractors in clearing the streets in the shortest possible time after a storm has started.

In New York City, under the methods that have been worked out for this winter by Commissioner J. T. Fetherston, the contracts for snow removal provide for loading and hauling only of snow from scheduled streets to certain specified dumps. Payment is made upon the basis of the number of loads hauled and dumped by trucks of certified and measured capacity, and all trucks must be loaded to the maximum rated capacity.

On all contract streets and avenues, as well as on all streets and avenues which are described in the snow removal schedule made out by the Department early in the fall or late in the summer, and which may be assigned to the snow removal contractor, and on all streets and avenues which are not mentioned in these schedules, but which may later be assigned to the contractors, the city will pile the snow and ice but once for removal by the contractors.

Then after the snow and ice on any street or avenue has been piled this once by the city, the contractor must completely remove the piles so that the street surface beneath the piles, as well as all adjoining street surface, shall be entirely free from all snow and ice. All of the snow and ice which may have become separated from the piles, or which has been scattered or otherwise disturbed in the process of loading the vehicles, or by street traffic, must in every case be gathered up and removed by the contractors.

Should any further piling of the snow and ice become necessary on any street or avenue upon which the city has once piled the snow and ice, this additional work must be done by the contractor at his own expense.

ORGANIZATION OF THE CONTRACTOR'S FORCE.

The contractor's force is, in each of the snow removal districts, organized into gangs of trucks and laborers, each gang working on a given schedule. For supervision, direction and the checking of this work, the force of city employees assigned to this duty work under titles as follows, in the order of superiority:

Superintendent of Snow Removal, Assistant Superintendent of Snow Removal, Borough Superintendents, District Superintendent, District Snow Inspectors, Loading Foremen, Dump Foremen, Assistant Loading Foremen.

The loading, assistant loading and dump foremen are assigned to their respective duties from City Department other than the Department of the Street Cleaning.

While they are engaged in the work of snow removal, all employees from other City Departments are subject to all orders and rules of the Department of Street Cleaning. Violations of the rules as laid down, neglect of duty or other infractions of the regulations of the Department of Street Cleaning will result in charges being preferred against them in the same manner as though the infractions had occurred in their regular employment. Each day when reporting for work, the employees of other city departments are each required to fill out blank cards provided at the District Headquarters, entering thereupon his name, his regular department, the loading gang or the snow dump to which he is assigned, the time he reported for duty, and the time he finished work. This card is then handed after being properly filled out to the district superintendent.

The regular hours of duty are as follows:

Day Work—From six a.m. to five p.m. with one hour for luncheon from midnight to one a.m., unless otherwise ordered.

Night Work—From six p.m. to five a.m., with one hour for luncheon from midnight to one a.m., unless otherwise ordered.

When snow storms commence in the daytime, Department of Street Cleaning employees assigned to snow work are required to report at the district headquarters to which they are assigned. Other city employees assigned to snow removal work, whose regular duties do not keep them in constant communication with their departments, will get immediately in touch and keep in touch with their respective departments by telephone until they receive instructions to report for duty to the Department of Street Cleaning. Then, upon receipt of specific orders, each employee proceeds with all despatch to the headquarters of the district to which he has been assigned for work.

When the snow-fall starts at night, all employees from other city departments, as well as the employees of the Department of Street Cleaning are required to report without orders directly to the district headquarters on the following morning, Sundays and holidays included, and failure to appear for duty on these days is always made the basis for charges which are preferred against such employees.

Trucks are generally used in hauling the snow from the street to the dumping places, but these trucks usually have low sides, and sufficient quantities cannot be hauled. They are, therefore, built up to carry double and in some cases treble their cubical capacity. Trucks which are built up must be built up to an equal height on both sides and on one end. The other end may be lower, but it is required, however, that its height shall be equal to the height of the regular side boards, plus one-half of the height of the built-up portion of the sides. Instead of this arrangement, it is also permitted to have both ends lower than the sides by one foot, but in all cases it is required that the sides be equal to one another in height.

For checking the work performed by the contractors, all trucks are tagged by the Bureau of Weights and Measures, with a district series of one hundred to two hundred numbers for each district, arranged in ten sets arranged alphabetically by the letters A to J, inclusive. Numbers from 1 to 1,399, inclusive, are assigned to the Borough of Manhattan, from 2,000 to 2,899, inclusive, are assigned to Brooklyn, and from 1,501 to 1,699 are assigned to the Borough of the Bronx. These numbers as arranged, therefore, show instantly to which borough and to which district any truck belongs.

In each district throughout the city where the snow is removed from the streets by contract, the Bureau of Weights and Measures commences with the first storm to issue numbers in order in Series A, keeping on issuing form this series until the tags are exhausted, and then commences on Series B, continuing in this manner throughout the season.

(*To be Concluded Next Month*)

## "Unqualified Success" does not Begin to Describe Concrete Road Conference

WITH a registration totaling close to 700 highway engineers and contractors, with an attendance at all sessions crowding the convention room at the Auditorium Hotel to the doors, even at the close of long drawn-out sessions, with addresses and committee reports of the highest order followed in nearly every case by animated and lengthy discussions, the second National Conference on Road Building, held at Chicago, February 14-18, 1916, goes down in history as one of the most successful engineering conventions every held, many would make it *the* most successful.

Procedure was much the same as that of the first Conference held two years ago, though the program was longer, occupying four days with six sessions.

Committee reports were most complete; when published together with the discussions they will form a reference work on concrete paving such as is not found on any other type and, in fact, hardly equalled on any other engineering topic; representing as it will the opinions and experiences of the country's most noted highway engineers.

Following the procedure of two years ago, a Committee on Resolutions was appointed at the opening of the Conference and all matters of business referred to it, including sub-committee reports. Part of the report of this committee, consisting of "Recommended Practice," etc., is found at the end of this article.

Thanks were extended to those who originated and carried on the work of the Conference and likewise to those devoting so much of their time to committee and other work. It was resolved that the Advisory Committee be continued, with a view to making arrangements for a third conference.

### ADDRESSES.

Among the nationally prominent speakers giving talks at the conference on topics covering the broad phases of permanent road building were Henry B. Joy, President of the Lincoln Highway Association; Major A. A. Fries, U. S. A.; Edward Hoopes, of the Fidelity & Deposit Company of Maryland, and S. M. Williams, of the Garford Motor Truck Company.

The paper of Major Fries was particularly interesting. Beginning with the statement that the subject was a difficult one to cover, owing to restrictions imposed by the War Department and other reasons, Mr. Fries not only summarized in a comprehensive way the functions performed by a network of improved roads in times of war, but gave a most forceful presentation of the nation's needs in the way of trained men and equipment.

Mr. Fries told of the ancient Roman roads; how they enabled the Roman legions to travel quickly to any part of the Empire, but when the Empire fell to decay through the mental, moral, and physical decline of its citizens, those same roads enabled the barbarians from the north with equal rapidly, to march upon Rome and overrun and lay waste the Empire.

So it might be with this country, if we were to build roads but not train our citizens in the art of defence.

The importance of the automobile in the rapid movement of troops in modern warfare was spoken of as the best argument in favor of road improvement. Paris was saved during the 1914 drive of the Germans because of the ability of the French to bring vast numbers of trained men to the front in automobiles, traveling over the good roads around Paris.

Both Mr. Joy and Mr. Williams spoke upon the relation between the automobile and permanent roads, though from different angles.

The educational work accomplished in two years by the Lincoln Highway Association was well summed up in the statement that "two years ago it was only with the greatest difficulty that we could get counties and townships along a designated route to co-operate with us in building 'seedling miles.' This year we are overwhelmed with requests for aid along this line."

As Mr. Joy's paper related to the effect of motor passenger vehicles on the good roads movement, so Mr. Williams dealt with the same subject from the point of view of the motor truck, bringing out the fact that without good roads and permanent roads in the rural districts, motor haulage would be confined entirely to city streets. Why the motor industry does not pay far greater attention to educating the public, particularly the rural inhabitants, upon the benefits of permanent highway construction, is a question which Mr. Williams could not answer.

### TECHNICAL PAPERS.

Space forbids all but the briefest mention of some salient features in the various sub-committee reports.

### WIDTH.

Committee II. on "Economical Widths of Pavement and Shoulders" reported that "as a general rule the construction of a single track of concrete road is uneconomical." Much discussion obtained on this point and while practically every one admitted that in the south, on strictly rural roads in gumbo soil localities, etc., there is considerable field for single track roads; after all the apparent differences of opinion arose more over the wording of the report than through any substantial disagreement with the evident ideas of the committee.

### GRADES.

Committee III. recommended, among other things, that except in arid regions, five or six per cent. is about the limiting grade for concrete pavements finished with wood floats. Though the point was brought up that Sioux City had concrete pavements on sixteen per cent. grades and Kansas City on nineteen per cent., both proving successful, nevertheless there was little exception taken to the committee's report on this point.

### AGGREGATES.

Committee IV. presented a very comprehensive report on the subject of aggregates, giving recommendations as to the testing of aggregates and mortars, together with proposed specifications for aggregates for one course concrete roads. There was considerable discussion of these specifications, particularly with regard to the allowable fineness of sand.

### HAULING AND ORGANIZATION OF CREW.

The reports of committees V. and VI. were of particular interest to contractors. In each report emphasis was laid upon methods calculated to avoid delays in the work. In concrete road construction, everything centers around the operation of the mixer and every effort should be made to keep sufficient quantities of all materials and supplies on hand, in order that the mixer may be kept running continuously.

### MIXING AND PLACING.

To obtain data for their report on "Mixing and Placing," Committee VIII., with the generous assistance of the T. L. Smith Company and Lewis Institute made a very comprehensive number of experiments, both in the field and in the laboratory. A study of the report and its appended tables leaves little doubt as to the correct proportion of water and most practical amount of mixing to give the best and strongest concrete.

Briefly, the recommendations of the report are:

(1) The mixing drum should revolve at speed not to exceed sixteen R.P.M.

(2) The minimum number of revolutions for each batch to be ten.

(3) The minimum length of time for mixing each batch to be one minute.

Particular emphasis was laid upon obtaining a correct and uniform amount of water in each batch by weight or otherwise, this point being brought to the particular attention of the committee by the water weighing device on the new Smith machine used in the test.

With regard to the use of a boom and bucket or chute, the committee saw "no reason for favoring one method over another."

### REINFORCING.

A discussion of the report of Committee IX. showed much difference of opinion among engineers in regard to reinforceing concrete pavements. Some, including the committee, thought all concrete pavements should be reinforced. Others could not see any use in reinforcing even the widest. In general, however, it was apparent that many more engineers favor reinforcing to-day than was the case two years ago.

### JOINTS.

Joints was another subject on which there appeared to be much diversity of opinion; at least in regard to the use of metal

plates for protection. It will be noted that the committee on resolutions did not make any recommendations one way or the other.

EXPANSION AND CONTRACTION.

The report of Committee XI. on "Expansion and Contraction" contains a large fund of data from various prominent engineers, including those of the U. S. Bureau of Standards. In this connection, also, an interesting paper on the subject "Concrete Highways Subjected to Extremes of Temperature," by H. S. Van Scoyoc, was presented at one of the sessions.

FINISHING AND CURING.

The report of Committee XII. on "Finishing and Curing" contains a number of detailed drawings of strike boards and other contractor's equipment used in finishing pavements.

SHOULDERS AND CURBS.

Committee XIII. apparently thought that the particular subject of "Shoulders and Curbs" merited a little thinking rather than the collection of data on past practice; consequently there resulted a series of interesting cross section drawings of pavement sections designed for use under different conditions. These were very favorably commented upon.

MAINTENANCE.

Introducing the report of Committee XIV., the chairman stated that the matter had been gone into a similar way in that in which a doctor handles a case, namely to dignose the case first and then perscribe the remedy. The report outlines specific remedies for all known diseases to which concrete roads are known to be subject, together with a scale of fees (meaning cost data).

FORMS OF SPECIFICATIONS.

Fairness to the contractor was the point given greatest emphasis in the report of committee XV. It was pointed out that in the past, practice has leaned towards loading up the specifications with all manner of restrictions which might prove inimical to the interests of the contractor and that, in the end, the municipality has to pay for this, because the contractor charges a higher price for the work.

COST OF CONSTRUCTION.

Not only did committee XVI. gather together representative cost data from all sections of the country, but proposed a standard form of cost report. In collecting their data, the committee found no two reports could be very well compared, owing to the different methods employed in preparing such reports by the individual engineers, and, therefore, strongly recommended that some common basis be agreed upon.

Under the subject of cost, it should be noted that in a very interesting paper entitled "The Possibilities of Concrete Roads in Suburban and Rural Districts Near Large Cities," by E. W. Stern, Chief Engineer of Highways, Borough of Manhattan, New York, concrete was shown to be the most economical type of pavement to be used for heavy traffic arteries leading into large cities.

Another address, by J. J. Gaillard, City Engineer of Macon, Georgia, told of the economy of concrete and its growing use in southern municipalities.

ESTIMATING AND INSPECTION PROBLEMS.

The report of Committee XVII. describes in some detail the various factors entering into the cost of concrete road construction, making the report a useful manual to contractors and engineers alike. (This report will be published in full in the next issue.)

* * *

## Some New Things We Saw at the Cement Show Also Some Old Ones

THE best cement show ever held was the verdict, and it was a unanimous verdict. Attendance was extraordinary, although this might be accounted for in some measure by the attraction of the National Conference on Concrete Road Building. But sales, actual bona fide sales, were phenomenal. Ask any exhibitor

One manufacturer sold forty-three batch mixers of one type and others were not far behind, abundant proof of a wide-spread confidence that 1916 will spell "Good Business" for manufacturers and contractors alike.

Here are some of the things I saw:

**Cement.** The joint exhibit was a huge success and attracted most favorable comment. The large map of the Lincoln Highway Association, showing by tiny incadescent lights the sections improved with concrete, probably attracted the most attention, though the little model contrasting the paved alley (with concrete of course) with the muddy, fence-all-broken-down, garbage-can-lid-fallen-off alley was not far behind.

As stated in a former issue, [illegible] co-operated in getting up this exhibit.

**Crushers.** The Smith Engineering Works from Milwaukee was represented, showing a very complete contractor's stone crushing outfit, jaw crusher, elevator, screen, bins, etc., all on wheels, though the Armory roof came down too low and the wheels had to be removed.

The Universal Crusher Company, of Cedar Rapids, had about the same line of equipment, though not hitched together. Their same old stunt of passing rocks through several sizes of crushers, the last cute little baby affair, proved as popular as ever.

**Culverts and Culvert Forms.** G. A. Belnap, Connellsville, Pennsylvania, was a new face at the show. He manufactures metal forms for circular culverts.

Another new face was that of L. Davidson, a New York civil engineer, who has patented a new form of concrete sewer, which seems to have many good featurers, particularly with reference to the rapid disposal of snow.

Both the exhibits of the Hydraulic Pressed Steel Company, of Cleveland, and the Blaw Steel Construction Company, of Pittsburgh, presented formidable looking masses of armor plate, which we were informed were harmless sewer forms.

You know A. M. Shulz, of Schulz & Hodgson, Chicago, of course. He had to put one of his sectional culverts crosswise in front of his booth to keep people out—he could not talk to more than one at once.

Hewitt, of the Security Culvert Company of Minneapolis, did not resort to such measures, but then he had Benjamin Sellar to help him out.

E. J. Whalen, of Syracuse, New York, was not on the list of exhibitors, but he was right there at the show just the same with model culvert forms of aluminum and gold and possibly others set with jewels, though we didn't see them.

**Engines, Hoists, Pumps, Etc.** The American Hoist & Derrick Company, of St. Paul, Minnesota, heads this list, for one reason because their name begins with the first letter of the alphabet, but we guess they make a mighty good line of electric hoists, so it's all right.

The Brownwall Engine & Pulley Company, of Holland, Michigan (not Europe), had on exhibition a new line of horizontal gas engines designed especially for contractors, but do not forget they are paying some attention to the mixer manufacturers also.

All the contractors know the Byers Machine Company's (Ravenna, Ohio), hoist. It was so near our booth that we forgot to look at it until the show was nearly over.

Did you see the C. H. & E. (Milwaukee, Wisconsin), power-driven portable triple piston force pump? That sounds like a lot, but it's all on four little wheels and is especially designed for road contractors.

Holland, Michigan must be a great place. W. E. Dunn, formerly of Chicago, moved over there lately and this year we find him at the show with one of those oil engines that the Germans have been using for so many years and that will burn axle grease just as easy as gasoline. And he did not forget to bring along his little mixer, too.

Read the item on C. H. & E. above and apply the same in general to the Ideal Engine Company, of Lansing, Michigan. We do not suppose they are just alike by any means, but we will let the salesmen scrap it out. Of course, Ideal's main line is vertical gas engines.

Same with the New Way Motor Company, of Lansing. Their main exhibit consisted of engines for hitching onto farm binders, but that was merely for the sake of variety.

As usual the Novo people (Novo Engine Company, Lansing, Michigan), had had a lot of extra signs painted and stuck around on various and sundry concrete mixers. On casual inspection, one might have thought they had about forty booths at the show.

Many who wanted to buy steam engines, boilers, and things were to be seen around the booth of Orr & Sembower, Inc., of Reading, Pennsylvania. There seemed to be a lot of 'em, so we did not stop.

Out in the annex there was a formidable array of drums and gears, levers, and things over the top of which we just caught a glimpse of J. J. Moore, of the Thomas Elevator Company. (They make electric hoists, not elevators for sky-scrapers.)

If you did not go to the show you may think that the business of the Whitman Agricultural Company, of St. Louis, is to sell shares in a Mexican tobacco plantation. You're wrong. We saw a bunch of gasoline engines and what interested us still more, a neat little portable pumping outfit for road work.

**Joint Filler.** We met all our old friends from Sioux City, Iowa, at Philip Carey Company (Cincinnati, Ohio), booth. Why? Because Fred Smith, who had to buy a new belt after returning from his recent southern trip, was there except while attending the National Conference. Oh, yes. The Carey Company makes Elastite. But then, you knew it anyhow.

What do you know about an asphalt company exhibiting at the Cement show! But Pioneer (Lawrenceville, Illinois), was there with a line of asphaltic materials of greatest use to concrete road builders. Yes, they included joint fillers and also an improved form of thin, bituminous top.

**Mixers.** (Gee, but this is a list and we are going to have a fine time saying something different about each one.)

"Oil once a month" was the slogan of the American Cement Machine Company (Keokuk, Iowa), and the name of their new ten-foot paver is pretty nifty, too—'The Lincoln Highway Type.' "

One of the two machines of the Archer Iron Works, Chicago, seemed at first sight to have met with some kind of an accident, but we were informed that it had been divided into three separate and distinct parts merely to show the simplicity of its construction.

Right across the "street" was the Atlas Engineering Company, of Milwaukee. Mr. Bohl was as cordial as ever and said he expected to do a good business this year. And any one knowing Bohl believes what he says.

Some might not believe that the Automatic Concrete Mixer Company (Providence, Rhode Island), could adapt their machine to road work, but they say they are going to do it and we, for one, believe them.

E. M. McVicker, of the Badger Company (Milwaukee), fooled 'em. Some thought he would not be at the show, but in he came bright and early Tuesday morning and had both his machines, a mixer and paver, all set up and ready for business in a jiffy.

Chain Belt, of Milwaukee, informed us that they have had their designer busy of late, with the result that their big paver has been cut down nineteen inches in width. They are also going to have a "Rex" one-bag paver on the market soon, but it was not quite ready in time for the show.

We believe that the Besser Manufacturing Company, of Alpena, Michigan, makes a continuous mixer, but they did not have it at the show, but the Blystone Manufacturing Company (Cambridge Springs, Pennsylvania), had theirs there. But, we forgot, it is not a continuous mixer but one of those things open at the top, especially useful in mixing mortar and plaster as well as concrete.

The name Cement Tile Machinery Company (Waterloo, Iowa), does not suggest paving mixers and they did not have any on exhibition at the show, so if we had not inquired we would have come away without knowing they have a very handy little eleven-foot machine of the paving type.

Yes, we followed instructions to "inquire about the Cropp Double Chamber Mixer." A. J. Cropp & Company have moved, but they are still in Chicago.

About the smallest batch mixer we noticed at the show was that made by the Cummings Machine Company, Minster, Ohio, two cubic feet, but they have one a little larger, too.

Another manufacturer from our home State is the Elite (Elite Manutfacturing Company, Ashland, Ohio, 'nough said:

"The Eureka Machine Company, of Lansing Michigan, are putting out a batch mixer for the first time this year, but they still believe in continuous mixers and are still manufacturing them.

There were three or four big Feet, no, I guess we mean Footes, on exhibition in the Armory, Foote Concrete Machinery Company, Chicago). We noticed many new features particularly in regard to chutes, but, of course, they have boom machine, too.

Jaeger (Jaeger Machine Company, Columbus, Ohio), might have copied the Studebaker gold chassis stunt and dressed up a seven-foot policeman to guard their exhibit, for we noticed all the mixer drums were made of pure gold, but there was always a large crowd around the exhibit and possibly this offered sufficient protection.

Look for "Made in Cincinnati, U. S. A." on the "Ideal Cincinnatus Traction Paving Mixer." They are made by the Ideal Concrete Machinery Company, of Cincinnati, Ohio.

We are afraid that when the wimmin get the vote, the Milwaukee Concrete Mixer Company (Milwaukee, Wisconsin), will go out of business. Yes, sir, they had a pretty young damoselle running their machine for an hour each afternoon just to show how foolproof it was.

The Miles Manufacturing Company, of Jackson, Michigan, is another company building both a batch and continuous mixer. Ask President Arnett which to buy. And don't forget his farm trailers. They are just as useful to contractors.

The demonstration of the Kent Machine Company (Kent, Ohio, showing how accurately their automatic feeder measures out material, was just as popular this year as last.

The Knickerbocker Company, of Jackson, Michigan, had three or four batch mixers on exhibition, but nary a paver. And we know they make 'em and sell 'em, too.

Duly warned that the Koehring (Koehring Machine Company, Milwaukee), crowd was going to "spring something" along in the middle of the week, nevertheless, we had to invest in a pair of smoked glasses before venturing to approach spaces 71, 72, 73, 74, 75, 86, 87, and 88. In spite of their dazzling color, we tried to "swipe" one of the badges, but there was "no chance." None of the seventy-eight salesmen would part with one.

Marsh-Capron and the Chicago Builders' Specialties Company combined as usual, and between them tried to catch everybody either coming or going to the Armory. We think they were successful, too; that paver was certainly an enormous one and commanded a lot of attention.

We did not know where to put Mr. McFarland's machine (W. L. McFarland, Fairfield, Illinois), but decided it had to go among the pavers. Actually it has two mixers on it and is calculated to lay and finish a sidewalk all in one operation.

The Municipal Engineering & Contracting Company, of Chicago, was "there" in more ways than one. A. C. Cameron was elected President of the National Association of Mixer Manufacturers at their meeting held on Wednesday, the sixteenth.

We will have to put the Northfield Iron Company, Northfield, Minnesota, among the mixers, too, because of their slush mixer, though they also make corrugated culverts and lots of other road machinery.

Satisfied with the show? Well, I should say yes! according to T. W. Rosholt, of the Northwestern Steel & Iron Works, Eau Claire, Wisconsin. It was Northwestern's first cement show and now they are going out to the Omaha show and several others, so we were told.

Probably the little freak mixer (yes, **they** called it that) on three wheels, attracted most attention at the Schaefer booth (Schaefer Manufacturing Company, Berlin, Wisconsin), but they had others, too, that did not need a label.

The Olson Concrete Mixer Company, of Elkhorn, Wisconsin, also has a small mixer of rather different design. They are going to make a paver out of it, too.

Like many others, the Oshkosh Paver was left at home (Oshkosh Manufacturing Company, Oshkosh, Wisconsin). But then, they had only two or three spaces and had to show mixers, saw rigs and also one of those little back fillers that we described a few months ago.

We wonder why so many of the mixer people left their pavers at home. The Republic Iron Works, of Tecumseh, Michigan, have a one-bag batch paver, brand new this year, but they did not bring it down so we could see it. They are going to send us a catalogue, though, and they'll send you one, too, if you like.

But the T. L. Smith Company, Milwaukee, Wisconsin, brought **their** paver down to the show and don't you forget it. With their new water weighing device and so many other new features, you can just **bet** they brought it.

The Standard Scale and Supply Company, Pittsburgh, had their same old five spaces in a row in the annex and it was chuck full of drab painted mixers. We have never seen the German army, but were reminded of it. Then, too, there may be other points of similarity—strength, reliability, etc.

The Waterloo Cement Machinery Corporation is another company bringing out its first paver this year. It is a "Dandy" one-sack machine.

There you are, there is the list. We hope you know which one to buy. We don't, but then, we are not in the market.

**Motor Trucks and Dump Wagons.** Rivaling the color and size of the Koehring badges was the America Dump Wagon, made by the American Dump Wagon Company, of Waterloo, Iowa. No, we never saw one like it before, but it looks mighty good.

Between the Federal, Garford, Mack, Service, and Sterling motor trucks, you will have to take your choice—they are all fine things for the road contractor (and the contractors know it), but we do not propose to steal any saleman's thunder.

Here they are: Federal Motor Truck Company, Detroit, Michigan; Garford Motor Truck Company, Lima, Ohio; International Motor Truck Company, New York City; Service Motor Truck Company, Wabash, Indiana, and the Sterling Motor Truck Company, Milwaukee, Wisconsin.

We will, however, have to say a word about the Gramm Bernstein (Gramm-Bernstein Motor Truck Company, Lima, Ohio). It was something entirely new, because the "whole business" went up in the air and not merely the front end.

**Road Machinery.** Austin Western (Austin-Western Road Machinery Company, Chicago), would have had to hire the whole Coliseum to put in their entire line of road machinery, so they contented themselves with their new tandem roller, with pictures of the rest. It was A. W.'s first time at the show.

The Baker Four Wheel Grader (Baker Manufacturing Company, Springfield, Illinois), was likewise on exhibition, though they did not have it fixed up so the wheels would go 'round as has been done at certain previous shows.

Galion, as usual, contented themselves with showing models of their big line. They also would have had to hire the whole Coliseum and then, anyway, if you want to find out what Galion has, all you have to do is to look on the back page of this magazine.

**Forms, Plates, Etc.** Triangle Mesh. We presume you know who makes it, particularly as we have given it first place under this heading. And we are following the alphabetical arrangement.

R. D. Baker, of Detroit, makes forms, protection plates, etc., but since last summer he has also been making a concrete road finishing machine and you should have seen the crowds watching it work!

Blaw (Blaw Steel Construction Company, Pittsburgh), makes all kinds of steel forms, you know, and this year had something brand new to show in the way of combined base and header form.

The Calumet Steel Company, Chicago, and the Carnegie Steel Company, Pittsburgh, both make reinforcing bars. Yes, they are sometimes used in concrete roads and as for highway bridges, well—.

H. D. Cornelius Company, of Indianapolis, was right up to date. Had a gold and silver curb form which they announced was patented on the twenty-sixth day of January, 1916.

Sidewalk Forms, Curb Forms, combined and Gutter Forms, anything you want in the way of forms, W. B. Jones Streater Boiler Company, will build it for you right down at Streator, Illinois.

Heltzel Steel Form & Iron Company, Warren, Ohio, had an exhibit of steel road, curb, and gutter forms that looked like the side of a battleship, but equally interesting was the lightning car unloader—something new.

A section of a concrete street in the exhibit of the Trussed Concrete Steel Company, Youngstown, Ohio, showed all the different uses of Kahn steel for concrete pavements. There were re-

(Continued on Page 44.)

# Better Roads and Streets

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The welfare of every city and village is bound up in transportation.

* * *

The greatest good for the greatest number can only be brought about by the building of better roads.

* * *

Although the claim is frequently made that gravel concrete is stronger than broken stone concrete, the authorities on the subject have failed to find substantial proof of this.

* * *

Some folks are urging that a minimum width of four-inch tires should be made compulsory for all vehicles using improved roads.

* * *

The editor is not engaged in the business of ditch contracting or in the sale of culverts, but you must get that water away from your road.

* * *

Another argument in favor of broken stone concrete lies in the fact that gravel is often covered with a film of dirt, difficult to remove, which lowers the strength.

* * *

There will never be maintained a proper equilibrium between the city and the country until farm life is made more attractive, and this is impossible without the improvement of public roads.

* * *

Main market or trunk line roads which are of great importance to tourists and motor traffic for commercial purposes form a system with which rural feeders could be connected by local political subdivisions and land owners.

* * *

Don't be discouraged for it wont be long until the water will either evaporate or soak in and you will be looking at the sign on the back of an automobile which reads, "Please excuse our dust."

* * *

The relative strength of mortars made from sand and from screenings of broken stone is now much discussed, but usually a mortar from broken stone screenings will show higher tests than mortar made from sand.

* * *

Comparative tests of broken stone and gravel concretes, in the same proportions by volume, show almost invariably that concrete made from hard, broken stone, such as trap or hard limestone, gives higher compressive strength than concrete made of gravel.

* * *

Sand or gravel when used in making concrete should be positively clean. You may obtain some idea of its cleanliness by placing it in the palm of one hand and rubbing it with the fingers of the other. If the gravel or sand is dirty it will badly discolor the palm.

Henry Welles Durham, formerly Chief Engineer of the Bureau of Highways of the Borough of Manhattan, New York City, has succeeded Ralph Earl as County Engineer of Bergin County, New Jersey, and is now located at Hackensack. This is one of the most important counties in the State, and as county engineer, Mr. Durham will have charge of the expenditure of several millions of dollars for improvements annually. Included in this will be much highway work and paving.

* * *

W. A. McLean, the former Chief Engineer of Highways of the Department of Public Works of the Province of Ontario, Canada, who is well known to hundreds of engineers and road officials in the United States, has been appointed Deputy Minister of Highways of the Province of Ontario.

* * *

The expense of construction of main market and trunk line roads which have little local traffic is such a burden upon local land owners that any increased expenditure in the cost of construction should concern both the States and the Government of the United States.

* * *

### PORTLAND CEMENT ASSOCIATION MOVES TO CHICAGO.

The headquarters of the Association of American Portland Cement Manufacturers have been removed from Philadelphia to Chicago, where offices have been established at 111 West Washington Street. Not only the general activities of the Association, but resources for extending its services to engineers, contractors and every class of cement users have been increased, and the Association extends to all who are interested in concrete construction a cordial invitation to visit the offices.

* * *

### CHANGE OF NAME.

The incorporated and business name of the Barrett Manufacturing Company has been changed to *The Barrett Company.* The numerous offices of the Company are at New York, Chicago, Philadelphia, Boston, St. Louis, Cleveland, Cincinnati, Pittsburgh, Detroit, Birmingham, Kansas City, Minneapolis, Louisville, New Orleans, Nashville, Salt Lake City, Seattle, and Peoria.

* * *

The picture used for the making of the front cover of this issue is not intended as an advertisement of any road material, but is there for our readers to have a glance at the actual condition of the large per cent. of the miles of public roadways in the United States. It is such as this that the Government of the United States is asking rural mail carriers to pull through in order to deliver mail to the rural folks; and this of itself ought to be an argument in favor of co-operation of the Federal Government with the States in the construction of national highways, and for the Federal Government to make it possible for a few folks at home to live on improved roads as well as to improve the public highways of the Philippine Islands, which possessions it is now proposed to give away or turned loose to themselves. What good can folks in the United States ever receive from the millions of dollars expended for the construction of public roads in such an island possession?

* * *

### NEW ROAD OILER.

You will recall reading an article on Berrien County, Michigan, in the November number of "BETTER ROADS AND STREETS" about a specially constructed motor road oiler which was doing such excellent work in oiling the macadam roads in that county. And having read this you will be interested to know that similar machines will be on the market this year put out by the Municipal Equipment & Construction Company, 111 W. Washington Street, Chicago.

Mr. J. E. Allen, who designed the Berrien County oiler, is President of the firm, and in addition to furnishing machines the company will take contracts for oiling if desired.

Several improvements have been made on the machine since last year, and these will be described briefly in the next issue of "BETTER ROADS AND STREETS." At this time we know only that it will be furnished with an internal or external heating apparatus as desired.

The Municipal Engineering & Equipment Company are also selling agents for the new Sterling-Kindling Motor Squeegee.

* * *

Another barrel mixer is on the market, made by the Barrel Mixer Company, Madison, Wisconsin. Not adaptable to pavement construction, of course, though it could be used for small culvert, curb and gutter, and sidewalk jobs.

## Some New Things We Saw at the Cement Show Also Some Old Ones

(Continued from Page 41.)

inforcing, road protection plates, curb protection plates, and we don't remember how many other things.

The Universal Concrete Bar Company, Chicago, had about the same idea, though they made it on a smaller scale and put it on a turn-table. Then, too, it showed not only a street but also an alley, illustrating how the universal bar adapts itself to the concave section.

**Gravel Plants.** The Raymond W. Dull Company, Chicago, had two spaces in the annex, but a couple of conical screens and one bucket filled them up completely.

Sauerman Brothers, Chicago realized the difficulty of such big machines and built a small model with all working parts complete. We would not have liked the job of operating it all day long, but it certainly did attract attention.

**Tools and Miscellaneous Equipment.** Step up, gentlemen; everything in the way of sidewalk tools from the Arrowsmith Concrete Tool Company, Arrowsmith, Illinois.

The Conneaut Shovel Company (Conneaut, Ohio), only had forty out of their 1,063 or so varieties of shovels on exhibition.

We couldn't describe the apparatus of the Great Western Manufacturing Company, Leavenworth, Kansas. It has a motor and a sieve and you shovel in gravel and the thing wiggles a little and it is all screened. You have to see it work to appreciate it.

Though covering only two spaces, the exhibit of the Insley Manufacturing Company, Indianapolis, Indiana, towered over all other exhibits in the Coliseum. It was one of those towers used in connection with gravity distribution, which is not of very much interest to road builders and they did not bring any of their excavating machinery along to the show.

That little portable contractors' water heater recently invented by Londelius & Sons, Chicago, attracted much attention, even at this time of the year when winter is nearly over. It seems to fill a long-felt want.

For the first time in many years Mr. Roughen, of the Roughen Adjustable Paving Gauge Company, Fon du Lac, Wisconsin, was not at the show. The gauge was there all right, but we regret that Mr. Roughen, Sr., was confined to his home by sickness.

**Sack Balers.** We mean it when we say that road contractors have not paid sufficient attention to sack balers. One reason probably is because they do not generally come on wheels and so are not especially adaptable to their work, but this year the Hargrave-Lewis Silo Company, of Litchfield, Illinois, intends to mount theirs on a small truck which can be hitched directly behind the paver.

"Handy Sack," of Cedar Rapids, Iowa, has a two-wheel attachment for his baler and we presume that the Faberhill Manufacturing Company, of Cleveland, Ohio, whose machine has the tying device, would also equip the machine with wheels if desired.

There now, go ahead and buy your equipment! This is going to be a record breaking year.

And if anybody is left out of the preceeding pages who ought to be in, don't hesitate to write us about it.

* * *

St. Louis County, Missouri, is talking a bond issue of $3,000.00 for improved roads, probably macadam.

* * *

The city of Carroll, Iowa, contemplates paving fifty-five blocks of streets this year. This is claimed to be the largest amount of paving ever done in one season by any city in Iowa of less than 4,000 inhabitants.

* * *

Ames, Iowa, with a population of a little less than 5,000, has let a contract for 300,000 square yards of paving to be laid during 1916—another record.

* * *

### THE STERLING-KINDLING MOTOR SQUEEGEE.

With a Brief Outline of Its Interesting History.

Few street cleaning officials but are familiar with the Kindling squeegee street washing machine, through its use either in their own city or in some neighboring one. Manufactured by the Kindling Machinery Company, of Milwaukee, it has been in use in America for the past ten years and for a considerably longer period in Europe.

The history of its introduction into this country is of considerable interest, but to tell of this necessitates telling something of the history of the manufacturer himself.

Louis Kindling was born in Berlin, Germany, and came to this country as a young man, in 1870. Settling in Milwaukee, he built up a substantial business as a cigar manufacturer and became one of the leading men of affairs in the city. An example of his interest in Milwaukee's civic affairs is found in his being a member of the Police and Fire Commission for about twelve years.

Ever since coming to America, it has been Mr. Kindling's custom to make an annual trip back to the Fatherland. While in Berlin on his 1905 trip, his attention was called to a squeegee machine which was at work on one of the streets. Mr. Kindling was much impressed with its operation, so much so that he looked up the manufacturer and inquired in detail into the history, design and cost of operation.

Becoming more enthusiastic all the time, the result was that he finally purchased one of the machines, brought it back home with him and presented it to the city of Milwaukee.

Its successful operation in that city led several of Mr. Kindling's friends to urge upon him that he start the manufacture of the machines for the American market. Reluctant at first, Mr. Kindling was finally persuaded to take up this suggestion, and on his next trip to Berlin, he purchased the American and Canadian rights from the German manufacturer.

Since that time, Mr. Kindling has manufactured and sold several hundred squeegees, placing them in New York, Chicago, Philadelphia, St. Louis, Boston, Washington and scores of other cities.

A history of the squeegee would not be complete without telling of the remarkable fate of one of the machines sold to the city of Hamilton, Ohio. This squeegee was shipped to Hamilton on trial just prior to the great Dayton flood of 1913. Stored in one of the street cleaning department's barns, when the flood subsided the squeegee was nowhere to be found.

The large empty water tank doubtless made it sufficiently buoyant to be carried along without difficulty by the rushing waters, but whether it sailed all the way down to the Gulf of Mexico or lodged in some farmer's barnyard to be used as a handy water tank, is a mystery which remains unsolved.

A search party was sent out by the city of Hamilton but found no trace of the fugitive machine. Later on, Mr. Kindling tried his luck as a squeegee sleuth, but without success.

With the present application of gasoline power to all types of vehicles including those used for street cleaning and refuse disposal, it is not strange to find the old well-known squeegee coming out in 1916 as a full-fledged motor-driven vehicle.

As described elsewhere in this issue, nearly a year ago Mr. Kindling had a demonstration motor squeegee built and tried out on the streets of Milwaukee. Careful cost records were kept by the Bureau of Municipal Research, which proved the new machine to be a decided advance over the old horse drawn gear. Success being thus assured, plans were laid to put the motor machine on the market in 1916.

Not being equipped to manufacture motor trucks himself, Mr. Kindling turned the entire motor squeegee business over to the large Sterling Motor Truck Company of Milwaukee, in whose factory the new machine has been designed with great care, with many improvements over the demonstration machine.



The illustration shows the final design. The machine consists of a special 3½-ton Sterling worm driven chassis upon which is mounted a 1000-gallon oval shaped steel tank.

Placed immediately in front of the front fenders of the chassis are two flusher nozzles controlled by the driver by a lever from his seat. The flusher nozzles by sprinkling the surface of the street prevent the agitation of dust and dirt, and also dampen the attached matter so that the squeegee roller can more easily force it loose from the pavement and wash the surface clean.

Supplementing the function of the nozzles in loosening the attached matter and to prevent the squeegee from being compelled to handle too large a mass of material, a pair of heavy pavement sweeping brooms are fitted immediately behind the front nozzles, the purpose of which is to force aside the large refuse so that it will become suspended in the water and run off into the gutters and sewers, leaving the squeegee to wash up the tightly adhered material by frictional action.

Mounted near the center of the chassis frame and immediately underneath is the squeegee—a spiral-shaped roller nineteen inches in diameter and eight feet wide.

All operations of the nozzles, brushes and squeegee are controlled from the driver's seat. A complete description of the machine with specifications is given in a new catalogue just off the press, which may be obtained from the Municipal Equipment and Construction Co., 111 West Washington Street, Chicago.

* * *

## Installs a 12-inch Sectional Culvert 19 Feet Long in Ninety Minutes

DIGGING a trench two feet deep through "buckshot" (heavy gumbo) soil, laying a 12-inch internal diameter concrete culvert in twelve sections with a total length of nineteen feet and replacing the earth over the completed culvert, without obstructing traffic at any time and all completed within one hour and a half, is the record established last month by County Road Superintendent C. R. Cox, of




*East Depot Street, Latrobe Pa., Tarvia-mixed-macadam over brick pavement.*

# *What they did with an old brick pavement—*

The old brick pavement on East Depot Street, one of the best residential streets in Latrobe, Pa., was badly worn and full of uneven places.

The authorities felt the need of improving the street which is on the main trunk line for automobiles between Philadelphia and Pittsburgh, but decided that instead of going to the great expense of repaving with brick they would have it resurfaced with a hot "Tarvia-X" and crushed stone mixture. As a foundation the brick still has possibilities.

The surface of the pavement was thoroughly cleaned and the depressions filled with the hot mixture which was compacted by rolling, after which the pavement was ready to receive a two and one-half (2½) inch course of the Tarvia-mixed-macadam surfacing. After the mixture was uniformly spread it was covered with a light course of clean stone chips, and rolled to a finished depth of (2) inches.

A seal coat of Tarvia was then spread over the entire surface and covered with stone chips, followed by the final rolling. The street was closed for several days while the mixture was in process of setting, after which traffic was admitted.

As a result Latrobe has a beautiful pavement, smooth, quiet and durable, at a comparatively small expense. The worn-out brick makes an ideal foundation—better than a new foundation. Its very roughness becomes a virtue since it interlocks with the new Tarvia-mixed-macadam surfacing. "Tarvia-X" is the only bitumen suitable for this purpose. Other bitumens lack the essential capacity of adhering to the brick.

We have had considerable experience with "Tarvia-X" for resurfacing worn-out brick pavements and shall be glad to give any one interested the benefit through our Service Department.

*Booklets on request.*

## *Special Service Department*

This Company has a corps of trained engineers and chemists who have given years of study to modern road problems.
The advice of these men may be had for the asking by any one interested.
If you will write to the nearest office regarding road problems and conditions in your vicinity the matter will have prompt attention.

The Barrett Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati
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Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

TRADE B MARK

Greenville, Washington County, Mississippi. Four negro laborers working under the personal supervision of Mr. Cox accomplished this record. Hall interlocking concrete culvert units were used.

Washington County lies in western Mississippi bounded on the west by the Mississippi River in what is known as the "delta" country. The river lies higher than the adjoining land.

Formerly swamp land, the country has been drained by means of large canals traversing the entire region and leading off, not to the Mississippi River, but to the Yazoo and its tributaries to the East, which eventually flow into the great waterway near Vicksburg, 100 miles south.

Descriptions of this country and the great drainage work, particularly the excavation of the big ditches with steam shovels and other heavy machinery, are to be found in back volumes of the engineering weeklies.

Such large timber as originally existed has all been cut and the land is, therefore, sometimes called "stump land."



Fig. 1

The stumps and remaining small timber and brush are rapidly being removed and the land turned into productive farms.

Well-drained roads are becoming a necessity.

Because of the low and swampy nature of Washington County, culverts are necessary at frequent intervals along the roads, to take care of natural drainage but more largely, that which is artificial, that is, lateral ditches leading to the big drainage canals.

The roads, of course, are largely of earth and, in general, are not graded up much above the general level of the surrounding country. Consequently, all culverts lie close to the road surface with only a few inches of fill over them.

The culvert installation described in this article was five miles out from Greenville on the Rattlesnake Bayou Road, which road parallels the Mississippi River south from the city. A trench about two feet deep was necessary and the fill over the culvert averaged seven inches. On the day of the installation, the river gauge showed the near-by Mississippi to be 45 feet, 5 inches above low water mark.

The culvert sections were furnished by the Delta Concrete Culvert Company, of Greenville, a concern which has purchased the county right on the culvert from Schulz & Hodgson, Chicago, for Washington and ten adjoining counties in Mississippi.



Fig. 2

The president of the company is J. S. Allen, C. E., formerly city engineer of Greenville. With Mr. Allen is associated an electrical engineer, R. B. Claggett, General Manager of the Delta Light & Power Company. Mr. Allen is shown at the right and Messrs. Cox and Claggett at the left in Fig 3.

Installation of the culvert was as follows:

Beginning at the upper end, the laborers, with picks, crow bars, and shovels began excavating the trench to the required depth and a few inches wider than the gross diameter of the culvert, to allow convenient placing and lining up of the sections.

Placing of the sections, beginning with the upper headwall section, and backfilling, followed immediately upon excavation, in order that traffic over the road should not be interrupted. During the hour an a half in which the culvert was being installed, two motor and three horse drawn vehicles passed over the road.

One of the horse vehicles is shown in Fig. 2, which is included for its "local color." While passing the work and just before his picture was snapped, the occupant of this interesting one horse-power rig was asked his name.

"Henry Fohd, cap'n."

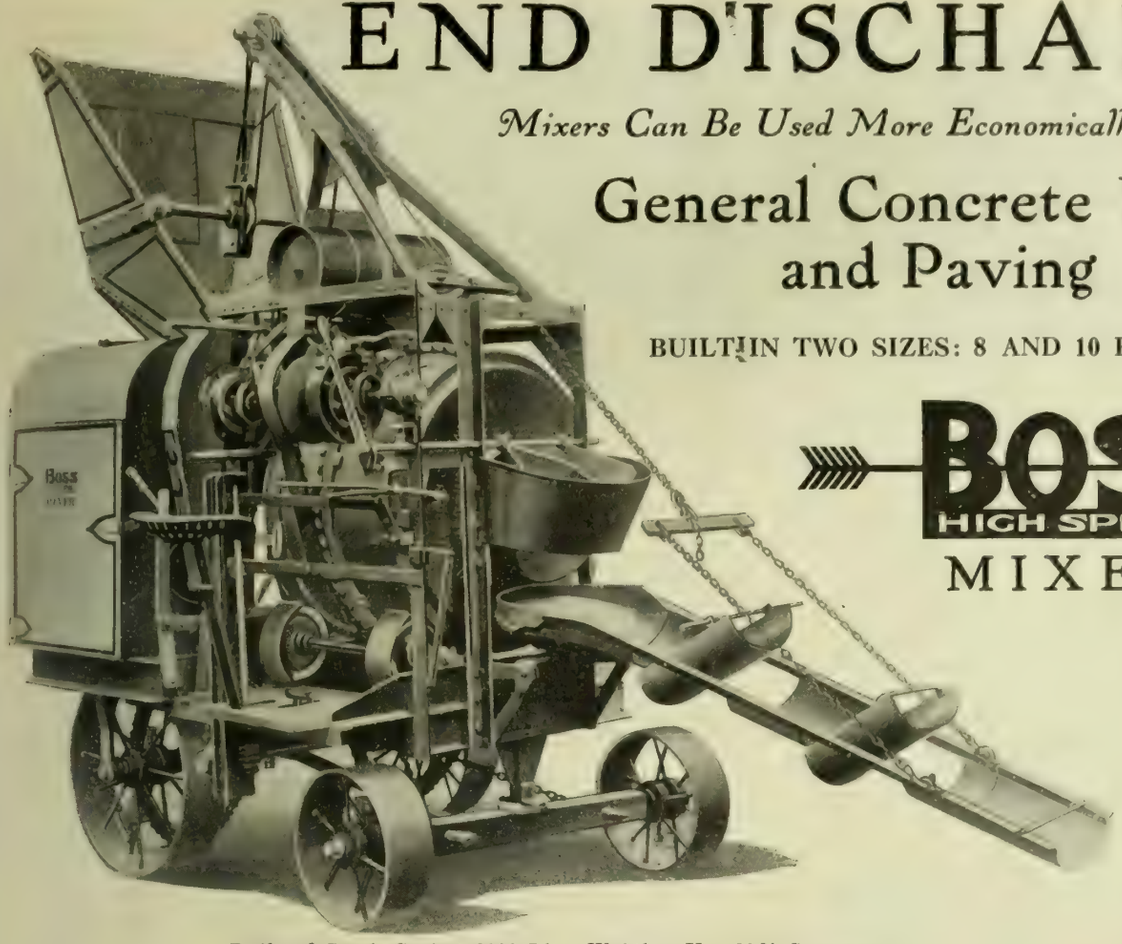
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Discharges entire batch in 12 seconds.

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**The American Cement Machine Co., Keokuk, Iowa**

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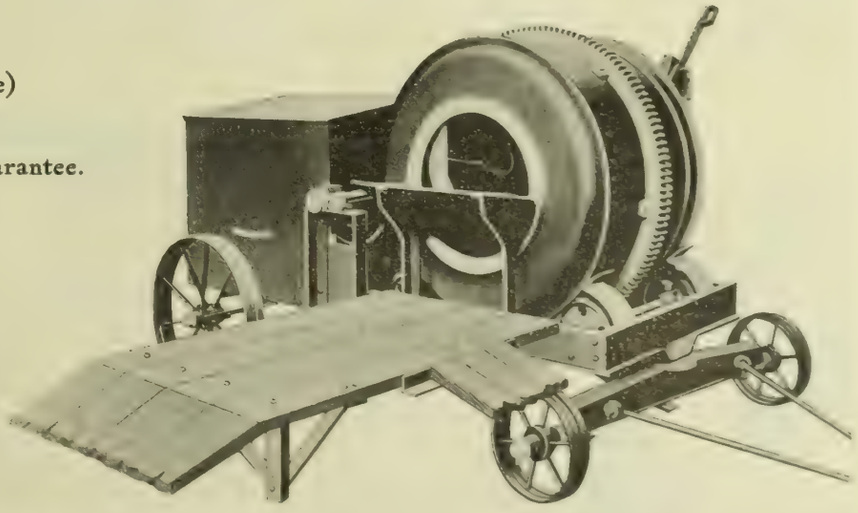
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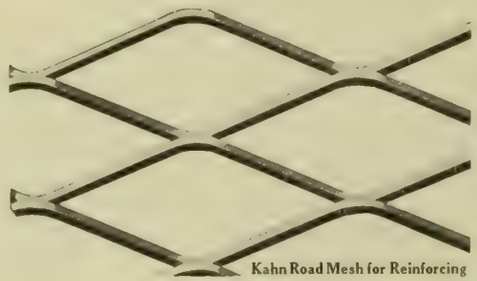


**The American Cement Machine Co.,** (Packard Division B) **Keokuk, Iowa**



ALLENTOWN-EASTON CONCRETE ROAD

# *Kahn Road Mesh for Reinforcing Concrete Roads*



Kahn Road Mesh for Reinforcing

Kahn Road Mesh has firmly established itself as the ideal reinforcing metal for a permanent concrete pavement.

Being manufactured from one-piece metal plates, it assures the user, exceptional strength and rigidity and a perfect reinforcement. No unrolling of coils, no cutting to length, no tying in position.

Kahn Road Mesh is shipped in large, flat sheets that are easy to handle. The pouring of concrete or other jarring cannot displace your reinforcing when once in position.

Kahn Mesh has no equal as a reinforcing material and fulfills all specifications.

# *Kahn Armor Plates for Protecting Paving Joints*



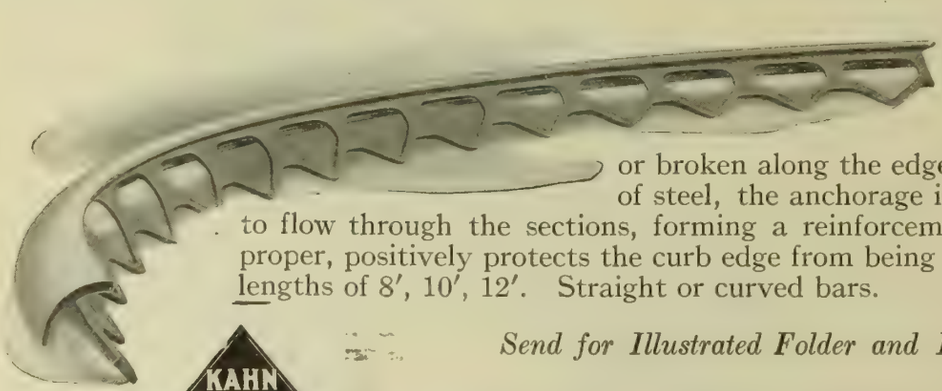
Kahn Armor Plates, note bevel edge construction

Kahn Beveled Edge Armor Plates positively protect the edges of the pavement from chipping or cracking at the expansion joint.

The beveled edge (an exclusive feature) eliminates the square corner of the concrete next to the plate.

Kahn Armor Plates are manufactured from a dead, soft open hearth steel of just the quality to withstand shocks and to wear down with the pavement.

The Split End Prongs and the Beveled Edge provide a solid anchorage in the concrete bed that no wear nor traffic can loosen.



# *Kahn Curb Bars*

Prevent all possibility of concrete curbing being chipped or broken along the edges. Made from one solid piece of steel, the anchorage is such as to allow the concrete to flow through the sections, forming a reinforcement for the curb, while the bar proper, positively protects the curb edge from being scraped or broken. Standard lengths of 8′, 10′, 12′. Straight or curved bars.

*Send for Illustrated Folder and Prices.*

KAHN Building Products TRUSSED CONCRETE STEEL CO

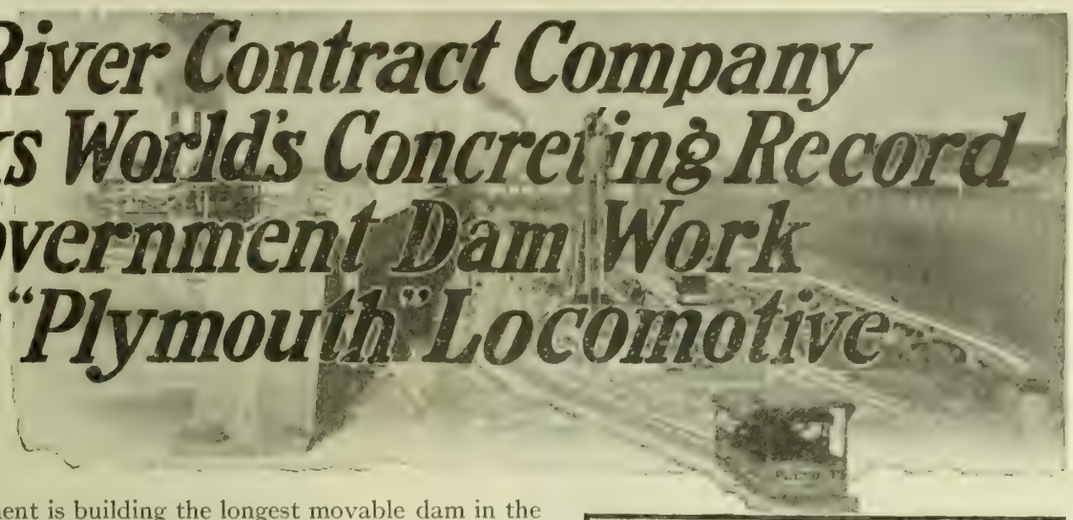
## *Trussed Concrete Steel Company*

**Department A-57** **YOUNGSTOWN, OHIO**

REPRESENTATIVES IN PRINCIPAL CITIES

KAHN Building Products TRUSSED CONCRETE STEEL CO

# Ohio River Contract Company Breaks World's Concreting Record On Government Dam Work With a "Plymouth" Locomotive



The U. S. Government is building the longest movable dam in the world in the Ohio River, 18 miles below Evansville, Ind.—and the only one ever constructed on a shifting sand foundation.

In its construction the contractors, The Ohio River Contract Co., are using two "Plymouth" Gasoline Locomotives, and these two little Giants have not only broken the world's concreting records but have cut them in HALF.

## Read the Remarkable Figures in This Great Feat

The following figures are taken from a report made by Leslie P. Eichel, Secretary of The Ohio River Contract Co., of Evansville, Ind., and give an idea of the manner in which these two "Plymouth" Gasoline Locomotives have speeded up the work:

"The 'Plymouths' operated maximum round-trip of 1600 feet, with stop for loading concrete at mixer and for dumping material. The average time for each 'Plymouth' was 4 minutes, day and night, for 22 days, including all breakdowns of concrete machinery."

"We placed, using one 'Plymouth' half the time and two other half, 9810 cubic yards in 269 hours, including all delays."

"In 12 hours, on 1600-foot run, 513 cubic yards with two 'Plymouths,' 475 cubic yards in 12 hours."

"On a long run, 355 cubic yards in 8 hours with two 'Plymouths.' "





# The "Plymouth" Gasoline Locomotives

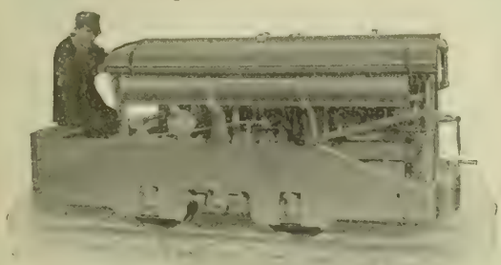
## Made These Feats Possible, and Besides Saved $44 in Haulage Cost Every 8 Hours

The Ohio River Contract Co. not only gives the "Plymouths" ALL the credit for these records, but says that each "Plymouth" saved it $22 on each 8-hour shift in actual cost, comparing each locomotive with SIX MULES which they replaced.

## Here's How "The Plymouths" Did It

There are three BIG reasons why the "Plymouths" could speed up this work as they did and at the same time reduce the cost to such an extent—Plymouth FRICTION Drive, Plymouth LOW FUEL Consumption, and Plymouth LOW LABOR Cost—

And here's why these Plymouth features are superior to all other locomotives—no matter what power:



1 Plymouth Friction Drive has variable speeds and picks up load quicker than any other power.

2 Plymouth Fuel Consumption averages only FIVE gallons of gasoline per day.

3 Plymouth Labor calls for only one unskilled man at minimum wage, no engineer necessary.

## THE J. D. FATE COMPANY

209 Riggs Ave., Plymouth, Ohio

## Get the Complete Story

as told by

## The Ohio River Contract Co.

We have a small folder that gives a complete record—all by Secretary Eichels of The Ohio River Contract Co.
Full cost per ton-mile, length of hauls and many other interesting figures —a truly wonderful array of facts!

## FREE—Send for It

It is interesting to every contractor and every manufacturer who has a haulage problem and we believe we have enough for all that ask for it, but don't take a chance--Send TODAY.

THE J. D. FATE COMPANY
209 Riggs Av.
Plymouth, Ohio

Send us The Ohio River Contract Co.'s Folder. This does not obligate us.

## Use the Coupon

For your convenience the coupon at the right, but a post card will do if you prefer. Just ask for the Ohio River Contract Co's Folder—

(Firm Name)_____

(Your Name)_____

(City)_____

(Street)_____

(State)_____



One of many "Armco" Iron Culverts on Mt. Diablo Boulevard overlooking San Francisco Bay.

# Long Service Life

is the object sought and attained in the manufacture of

## ARMCO AMERICAN INGOT IRON CULVERTS

Their material is the standard for Purity and Rust-Resistance, and their construction is, in every detail, that which characterizes a quality product.

Pure Iron Corrugated Culverts are adapted to the rough-and-ready conditions of the dirt road, and to the finished excellence of the modern boulevard.

Where end-walls are not employed, the wearing away of a bank or fill at the outlet may be prevented, as in the installation here pictured by a slight increase in the length of the pipe.

For full information on "Armco" Iron Culverts, Flumes, Sheets, Roofing and Formed Products, write

**Armco Iron Culvert Mfrs. Association**

Cincinnati, Ohio

TELL 'EM YOU SAW IT HERE.

Fig. 1 shows the culvert about half completed. The arrow points out the upper headwall.

Fig. 3 is a view from the lower end showing the trench and the simplicity of installing the culvert.



Fig. 3

The cost of placing the culvert including the time taken by laborers going to and from the work, 10 miles, was as follows:

| | |
|---|---|
| Team, ½ day at $4.00 | $2.00 |
| Four laborers ½ day at $1.25 | 2.50 |
| Total | $4.50 |
| Per foot length | $ 0.24 |
| Purchase price | 1.00 |
| Total cost in place per foot | 1.24 |
| Total cost of culvert | $23.00 |

* * *

## Branch Managers' Convention Great Success

The week of January 25-28 was a notable one for the Trussed Concrete Steel Company, as it marked the first annual convention of the branch managers held at their main plant at Youngstown, Ohio. Men gathered from every section of the country to co-operate in forming improved methods which would render greatest service to their clients. Not only every section of the country was represented, but representatives came from far distant countries, including Japan, Hawaii, South America, and Porto Rico. Fully one hundred men were in attendance.

The general program of the convention included business sessions every morning and afternoon. Mr. Julius Kahn, president, gave the opening address, followed by an interesting talk and discussion on "Shop Practice" by T. H. Kane, Manager of Works. The noon recess was devoted to a thorough inspection of the manufacturing operations with a competent corps of guides to explain all the details.

The subject of "Steel Sash" was ably handled by P. M. Louwerse, Manager of the Sash Department. Many interesting points dealing with the manufacturers of the various types of sash were brought out, as well as information on Stock, Sash, Semi-Stock Sash and To-Order Sash. The branch managers entered into the discussion vigorously and told of their experiences in various parts of the country.

On the subject of "Reinforced Concrete" many interesting points in regard to Design, Systems of Construction, and Local Requirements were brought out. R. D. Snodgrass, Chief Engineer, talked on "Engineering Practice" and B. J. Sigmund, Philadelphia Manager, on "The Commercial Value

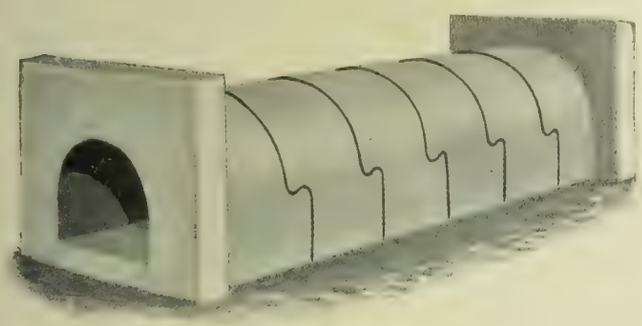
# Are You Guilty?

## Have You Been Wasting Money and Energy?
## Have you been building culverts by

1.—Using metal or tile pipes and building massive headwalls at the ends thus placing a Permanent Coping upon Temporary Pipe?
2.—Using corroding pipes as forms, pouring grout around them, thus making a triple cost for materials?
3.—Using wood or metal forms for monolithic construction, thereby losing half the money on haulage, and on wasted time, labor, materials?
No doubt you did the best you could, using the best methods at your command. Here's a chance to get in line on a new and profitable way of placing reinforced concrete culverts.

There is a Certain, Positive Profit in the manufacture of the Hall Interlocking Concrete Culverts under our exclusive contract.

*Send for our Illustrated Folder H-5.*



THE CULVERT EVERLASTING

SCHULZ & HODGSON
19 South La Salle Street :: CHICAGO

*THE SOLUTION OF THE SIGN PROBLEM*

# THE INTERCHANGEABLE CROSSROADS DIRECTION SIGN

**Gives any reading desired, for temporary signs: DANGER, SLOW DOWN, BRIDGE OUT, ROAD CLOSED, DETOUR—1 m. S. 1 m. W., USE THE WHOLE ROAD, Etc. Just the thing for ROAD NAME SIGNS and BRIDGE NUMBERS.**




Interchangeable Sign (Assembled)




Sign (Disassembled Showing Separate Letters and Back Plate)

Notice Top and Bottom Extensions Insuring Perfect Alignment and Proper Spacing Between Letters.

A
Plain
Permanent
Indestructible
Weatherproof
All-Metal
Sign

Order crossroads direction signs as you would anything else. Just say how many. Ten, fifty or a thousand at a day's notice. Keep a few on hand and put them up as you need them; it takes sixty seconds to permanently assemble a twelve letter sign.

THE INTERCHANGEABLE CROSSROADS DIRECTION SIGN conforms to the specifications of the State Highway Department.

The Ohio Culvert Pipe Co., Tiffin, Ohio, U. S. A.

"HARRIS PAVERS"
Daily Capacity 40,000
THE HARRIS BRICK COMPANY
Main Office CINCINNATI, OHIO
Factory ZANESVILLE, OHIO

"Hydrolene"
Asphalt Products for Road Building are Unsurpassed
Road Binders, Asphaltic Cements, Road Oil
SUN COMPANY
Toledo, Ohio Philadelphia, Pa. Chicago, Ill.

PENNSYLVANIA PORTLAND CEMENT
"For Better Roads and Streets"
PENNSYLVANIA CEMENT COMPANY
30 East 42d Street NEW YORK

McAvoy Vitrified Brick Company
PHILADELPHIA, PA.
"McAVOY BLOCK"

A. H. Blanchard
M. Am. Soc. C. E. M. Can. Soc. C. E.
Consulting Highway Engineer
Broadway and 117th Street New York City

of Engineering Service." Herman Fougner, New York Manager on "Experiences with Reinforced Concrete."

The subject of Hy-Rib and Metal Lath was brought out in interesting papers and discussion. Among these were "Metal Lath," by J. Earle Heber, formerly Los Angeles Manager; "My Method with Distributors," by Louis Baum, Kansas City Manager; "Concrete Pavements" with Armor Plates for protecting the joints, and "Kahn Mesh Reinforcement" occupied one of the morning sessions under the leadership of John Bowditch, Manager of the Highway Department. O. W. Chaffee, Manager of the Credit Department, spoke on "Credits and Collections."

The business sessions were so active at all times that it was found entirely impracticable to cover the entire program which had been planned so that a number of important discussions had to be postponed until another session. The Convention closed on Friday afternoon with a talk on general subjects by Gustave Kahn, General Manager of Sales.

A complete program was also planned for the evenings' entertainment. On the opening night, special motion pictures of Oregon views were given by J. A. Currey, Portland Manager, also an address on "History and Growth of the Company" by M. Goldenberg, Michigan Manager, followed by a buffet luncheon.

On Wednesday, a banquet was given at the Hotel Ohio. The banquet hall was especially decorated and arranged for the occasion, special company songs were rendered and many interesting toasts responded to. T. W. Murray, Associate Manager of Sales, was the toastmaster of the occasion.

The next evening was Trussed Concrete night at the Hippodrome Theater. Curtains carried banners of welcome, and all the actors had been coached to make special reference to the event and poke fun at the individuals in attendance. After the performance a buffet luncheon was served in the grill room of the Hotel Ohio.

Every man in attendance spoke enthusiastically of the value of the work done at the Convention, and carried away with him many new ideas which would be helpful to his clients in his territory.

* * *

The Standard Oil Company, of Indiana, sends us some neat and attractive new pamphlet, folder, or other printed matter dealing with the construction of some type of bituminous road. Presuming they are sent out also to a large number of our readers, we take occasion to remark that this class of material serves, not merely to remind road builders that the Standard of Indiana is alive and doing business; but, more

CHICAGO PAVING LABORATORY
LESTER KIRSCHBRAUN, Ch. E., Director
Consulting and Testing Engineers
Pavements and Paving Materials
160 N. FIFTH AVE., CHICAGO
Reports, Specifications, Plant, Street and Laboratory Inspection
Asphalts
Tars
Creosote Oils
Road Oils
Binders
Petroleum


JAMES H. MAC DONALD
Consulting Road and Pavement Expert
Chamber of Commerce Bldg., NEW HAVEN, CONN.
State Highway Commissioner of Connecticut nearly eighteen years.
Advice given on all phases of road building and street paving.
Consultations on specifications, materials and methods. Specialty of recommending efficient and economical equipment and plant Accurate estimates for contractors.

APOLLO-KEYSTONE Galvanized Sheets
Made from KEYSTONE COPPER STEEL—Unequaled
FOR ROADWAY CULVERTS
as well as for Roofing, Siding, Flumes, Tanks, and all forms of exposed sheet metal work. Demand APOLLO-KEYSTONE for your Roadway Culverts. Look for the stencil—it insures greatest durability and resistance to rust. Accept no substitute. Write for our free booklet showing actual service tests.
AMERICAN SHEET AND TIN PLATE COMPANY, - - - General Offices: Frick Bldg., Pittsburgh, Pa.

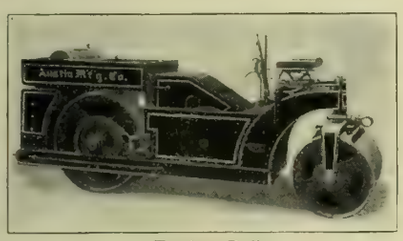
# Modern Municipal Road Authorities

demand as much uniformity and smooth working in their road and street equipment as they would in a well-selected fire fighting outfit.

## The Austin-Western Road Machinery Company

build an entire line of road and street machinery in their own factories. Each machine made under supervision of experts, all coöperating to produce the best and most suitable equipment for modern requirements. A well balanced, up-to-date Austin-Western road equipment works with uniformity and with the objects of efficiency and economy in view. Saving of time, money and trouble is the resulting service to the owner.

THE AUSTIN-WESTERN LINE INCLUDES:

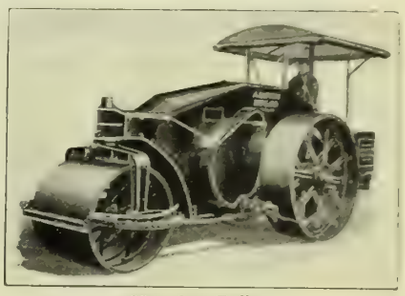


Tandem Roller



Oiler with Heater

**Motor Road Rollers,**
**Motor Tandem Rollers,**
**Road Scarifiers,**
**Rock Crushers,**
**Portable Stone Bins,**
**Stone Screens and Elevators,**
**Road Oilers,**
**Sprinklers,**
**Sweepers,**
**Stone Spreaders,**
**Dump Wagons,**
**Earth Handling Tools, Etc.**



Macadam Roller



Jaw Rock Crusher

*Write for new edition of* ***Road Builder's Guide*** *now ready.*

# The Austin-Western Road Machinery Co.

Chicago, Illinois

Agents and Warehouses Covering Every State in the Union.

"Yes--we ship ACME NESTABLE Corrugated Culverts SET UP if you want them that way."



We use the same 99.90% pure NO-CO-RO METAL.
—and the same care in every other department and process.
—as we do in the regulation "ACME" Culverts when shipped Nested.

We suggest that you get off a brief line now saying—"Send me Catalog G-2." It will certainly help solve your culvert problems.

Have you seen our "Special File" in facsimile of a bunch of "repeat orders," complimentary letters, inquiries for information, etc.? It is convincing reading. Yours for the asking.

THE CANTON CULVERT & SILO CO.
MANUFACTURERS
CANTON, OHIO, U.S.A.

The Sunbury Automatic Car Unloader

Highest Efficiency Lowest Operating Cost

Absolutely Automatic on Sand, Screenings, Slag, Stone, Small Coal, or Other Loose Material.

WRITE FOR CATALOGUE.

THE SUNBURY MANUFACTURING CO.
SUNBURY, OHIO

C. G. Milburn, Distributor, 600 Columbus Savings & Trust Bldg., Columbus, Ohio

important, to aid toward good construction with Standard and every other brand as well.

* * *

If you live in Illinois you should be acquainted with G. H. Reiter, consulting engineer of the Illinois Paving Brick Publicity Bureau, Chicago. The Bureau is a rather new organization, Mr. Reiter having been appointed last December soon after its formation, but much has already been done in the way of consultation and advice tending toward better construction, particularly with the new monolithic type.

If brick paving is contemplated, better get in touch with Mr. Reiter at once. He will be busy this summer.

* * *

Berrien County, Michigan, is considering the purchase of motor trucks to be used in repair work.

* * *

Following a careful investigation of the machine, the city of Milwaukee recently has purchased two Elgin motor pick-up sweepers.

* * *

"Build the maintenance into the Road" is the title of a little folder published by the Detroit Board of Commerce for distribution at their recent good roads meeting.

* * *

"Good Pavements and How to Get Them" is the title of the newest Barber Asphalt pamphlet. It gives photographs and data regarding many of the asphalt pavements in the State of Wisconsin, the genuine and justifiable pride of our genial (couldn't be otherwise) friend, E. L. Abell, of Milwaukee.

* * *

Two new bulletins have recently been received from the Tiffin Wagon Company, Tiffin, Ohio. The first, termed "A Supplement Regarding Tiffin Flushers," gives detailed data concerning the use of the Tiffin line of flushers and sprinklers, including information such as the yardage cleaned with one filling of the tank, the proper speed of operation, time consumed in filling tank, average gasoline consumption and similar figures.

The data are all based on actual tests, and should be in the hands of every street cleaning superintendent.

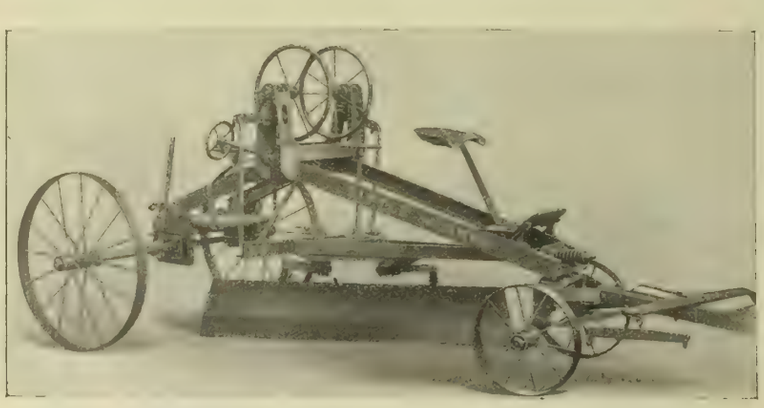
The second bulletin gives complete specifications for the Tiffin ¾-, 1-, 1½-, 2-, 5-, and 6-ton motor chassis.

* * *

"Everything For the Road Maker" is the title of a booklet which contains illustrations of road building machinery, tools and supplies, and a full description of each of them, manufactured by the Good Roads Machinery Company, Kennett Square, Pennsylvania. A postal card request to the company will bring to you one of these illustrated booklets.

* * *

Under the provisions of the State Highway Act, which became a law in 1915, Mr. A. M. Nelson has been elected State Highway Engineer of Tennessee. Mr. Nelson has been active in the engineering field for twenty-six years, and most of his work has been in the States of Colorado, Idaho, and Montana in the capacity of county engineer or in charge of some special road construction in these States. He is a native of Alabama. He is now busily engaged in the work of desig-



The AMERICAN Little Winner. For Two, Three or Four Horses

A REAL Road Machine

That's what you get when you buy an American Winner—no matter what size.

Here they are. Select the size that suits your work.

THE AMERICAN LITTLE WINNER
Weight 1600 pounds. Bar 6 feet long.

THE AMERICAN BIG WINNER
Weight 3100 pounds. Bar 8 feet long.

THE AMERICAN GIANT WINNER
Weight 5500 pounds. Bar 10 or 12 feet long.

*Write to-day for full information about the Winner line of Road Machines.*

The Good Roads Machinery Company
Kennett Square, Pa.



Type O Thew Gasoline Shovel in a Rock Cut

## *The Thew Gasoline Shovel Offers Many Advantages Over Steam Shovels*

—Eliminates the expense of getting coal and water to the shovel, a barrel of gasoline lasts two or three days.
—Eliminates the fireman, one man operates the Thew Gasoline Shovel to capacity.
—Eliminates boiler troubles.
—Saves an hour's time required for "getting up steam," simply crank the motor and you are ready to dig in five minutes.
—Eliminates the watchman required in cold weather, simply lock up the shovel and go home.
—Eliminates the smoke nuisance in city work.
—A licensed engineer not required, choose the operator for his ability to operate the Shovel rather than ability to pass an examination.

You would be interested if you felt that a Gasoline Shovel would prove reliable.
**The Thew Gasoline Shovel was forced to demonstrate its ability and absolute reliability** in a rock cut on road construction **for six months before** it was **placed on the market.**
By the installation of a heavy, powerful, slow speed Gas Engine, which had already demonstrated its ability and absolute reliability, upon a Standard Type O Thew Shovel any probable chance of failure was eliminated. Six months of most difficult road work showed the need of a few minor changes. These were made and the **Thew Gasoline Shovel** was offered with the same liberal guarantee and Thew policy back of it that is back of every Thew Shovel.

**You Are Taking No Chances When You Buy a Thew Gasoline Shovel.**

# THE THEW AUTOMATIC SHOVEL COMPANY

LORAIN, OHIO

Please send Circular 21-B which describes The Thew Gasoline Shovel.

Name .....

Address .....

Date ..... 1916



# THOROUGHNESS - *A Policy*



Warrenite hard surface pavement on Terwilliger Road in Multnomah County Portland, Oregon

With this Company, thoroughness is a matter of business policy growing out of our recognition of the demand for the best surface for country roads. A surface of a "quality" standard.

In meeting this demand there is no middle ground upon which a good road surface can be built. Therefore, in 1910 we offered the public such a road surface, namely, "WARRENITE, the Ideal Country Road."

WARRENITE has been laid to the extent of 480 miles of roadway, 16 feet wide, in many counties and States from coast to coast, and has given the counties an ideal surface at a reasonable cost.

After three years' practical test in the use of WARRENITE surface, the Multomah County Court (which county includes and surrounds Portland, Oregon) in June, after a thorough investigation of all substantial forms of road construction, awarded contracts for surfacing of 74 miles (of roadway 16 feet wide) of WARRENITE surface, this being, it is said, the largest country road contract ever let in America. The work is now under construction and it will be an example for other counties to follow.

A report of the Portland Chamber of Commerce special paving Committee, dated June 12, concludes:

. . . "We are certain that everybody concerned in this paving problem who is entirely disinterested, has been, and is now, seeking to get the very best available pavement for the county, because it is realized that, in so doing, the county will be furnishing an object lesson which will be an incentive to depart from the unwise policy of the past, which has resulted in throwing money away for useless macadam roads."

Don't hesitate—investigate for yourself or let us show you the value by surfacing your roads with WARRENITE.
Write to-day for illustrated booklets and learn more about this modern ideal road surface.
WARRENITE specifications and mixture agreement available to all contractors.

# WARREN BROTHERS COMPANY

**EXECUTIVE OFFICES:**
**BOSTON, MASS.**

DISTRICT OFFICES:

New York, N. Y., 50 Church St.
Chicago, Ill., 10 S. LaSalle St.
Rochester, N. Y., 303 Main St., West
Los Angeles, Cal., 926 California Bldg.
Portland, Oregon, Journal Bldg.
Phoenix, Arizona, 204 Noll Bldg.
Richmond, Va., Virginia Railway & Power Bldg.
Nashville, Tenn., 606 First Nat'l Bank Bldg.
St. Louis, Mo., Railway Exchange Bldg.

# Investigate Russell Road Machines

As Carefully As Did The Judges At The San Francisco Exposition And You Will Award Us Your Order As They Awarded Us The

# GOLD MEDAL

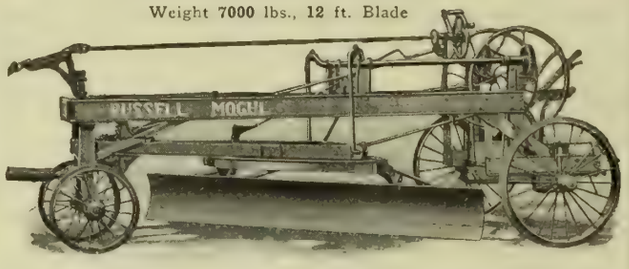
## We Make a Full Line of ROAD MACHINERY

### A Machine for Every Size Work

Road Machines, many sizes; Road Planers; Scarifiers, Elevating Graders; Disc Plows; Road Drags; Road Plows; Railroad Plows; Rooter Plows; Snow Plows; Wheel Scrapers; Buck Scrapers; Tongue Scrapers; Corrugated Galvanized Metal and Cast Iron Culverts; Steel Beam Bridges; Cutting Edges, etc.

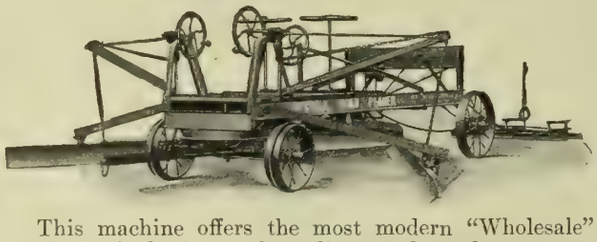
### The Russell "MOGUL"

Weight 7000 lbs., 12 ft. Blade




The Mogul is a gigantic road builder; has no equal in strength, durability, or capacity. It is built for tractor use only and the largest tractor cannot overtax its capacity. It is simple and very easily operated. Built principally of steel with but few castings. Most parts are forged.

### The Russell "PLANER"



This machine offers the most modern "Wholesale" method of planing and grading roads at lowest cost. Two sizes, No. 1, for tractors of 25 to 35 H. P. No. 2, for 8 horses or tractor of 15 to 25 H. P. One man operates it. Each blade adjusted independently of the other. Blades can be brought up close to machine. Dresses the entire width of road in one sweep.

**FREE TRIAL OFFERED ON ANY MACHINE**

SEND FOR FOR BIG 1916 CATALOG

**RUSSELL GRADER MANUFACTURING CO.**

MINNEAPOLIS, MINN.

REPRESENTATIVES IN ALL PRINCIPAL CITIES

TELL 'EM YOU SAW IT HERE.


nating an inter-county seat system of Highways for Tennessee which is provided for in the Highway Act of that State. For Tennessee it is a new law, a new commission and a new State engineer, and for them and their work we wish the greatest possible success.

* * *

Following the lead of Brown County on the east, there is a strong sentiment in Outagamie County, Wisconsin, to adopt the county system of road building, raise about $700,000 by means of a bond issue, and improve 100 miles of main road.

* * *

R. W. Scherer, of Minneapolis, former sales manager of the Trap Rock Company of that city, has been appointed to the position of Secretary of the Wisconsin Crushed Stone Association. Mr. Scherer will make his headquarters in Milwaukee.

* * *

We have just received Volume 1, Number 1 of The Monad, published by the American Association of Engineers, Chicago, Illinois, and congratulate the editors on its neat and business-like appearance, as well as the fund of interesting news and information contained in its sixty-four pages. Do not overlook page 50, last paragraph.

* * *

BONDING FOR ROADS IN ILLINOIS

Bond issues are a live issue in at least twenty-seven Illinois counties. Two counties have already voted bonds, fourteen are practically certain to vote on the question during 1916, and eleven more may do so. Following is a tabulation:

Bond issues voted: Cook, Vermillion.

Will vote this year: Adams, Iroquois, Kankakee, Livingston, Peoria, Rock Island, Winnebago, Edgar, Kane, LeSalle, Madison, Pike, Will, White.

May vote this year: Boone, Ford, McLean, Sangamon, Shelby, Crawford, Douglas, Lake, Piatt, St. Clair, Stephenson.

* * *

## Report of the Special Committee on Materials for Road Construction and on Standards for their Test and Use

(*Continued from page* 6.)

CEMENTATION OF ROCK, SLAG, AND GRAVEL POWDERS.

The cementation test shall be made as follows: Of the material to be tested, 500 grams shall be broken to pass a 1.27 centimeter (½-inch) mesh sieve and then placed in a ball mill with ninety cubic centimeters (3.04 ounces) of water and two steel shot weighing together nine kilograms (twenty pounds). The mill and its charge shall be revolved for 2½ hours at a rate of 2,000 revolutions per hour. The dough thus formed shall then be removed and twenty-five grams of an average sample of it shall be placed in a metal die, twenty-five millimeters (0.98-inch) in diameter, and subjected to a pressure of 132 kilograms per square centimeter for an instant in a hydraulic press. The cylindrical briquette resulting should measure exactly twenty-five millimeters (0.98-inch) in height. If it does not, subsequent samples of the dough shall be taken in such quantity that the resulting briquette after compression will be exactly twenty-five millimeters (0.98-inch) in height. Five such briquettes shall be made and allowed to dry in the air for a period of twenty hours, after which they shall be heated for four hours in a hot-air oven at a temperature of 93.3 degrees Centigrade (200 degrees Fahrenheit), and then cooled in a desiccator for twenty minutes. These cylinders or briquettes shall then be tested in a machine as follows:

The machine shall be arranged so that a one kilogram (2.20-pound) hammer is raised to a height of one centimeter (0.39-inch), and then falls freely on a plunger transmitting the shock of the blows of the hammer through the plunger to the test piece, successive blows being struck by the hammer at the rate of forty to seventy per minute, until the test piece fails, which is indicated by the failure of the plunger or hammer to rebound. The test piece shall be placed on the anvil under the plunger without lateral support, and may be fastened in place on the anvil by a drop of shellac. The average of the number of blows on the five briquettes, required to produce failure in each

# Why not do Hot Work and Cement Concrete Work with Same Mixer?

When you put good money into a mixer, why not get the mixer which will give you the biggest money-earning possibilities—the mixer that will handle cement concrete or the hot mixtures?



**Koehring Sizes in Cubic Feet Capacities:**

Mixers for Construction Work: 4, 7, 10, 12, 15, 20, 24, 30, 44. Equipped with low charging hopper, batch hopper and side loader.

Hot Mixers for Bituminous Pavements: 12, 20, 22. Side discharge type and end discharge type.

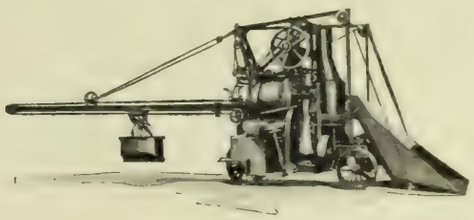
Paving Mixers: 6, 11, 16, 22. Equipped with distributing boom and bucket or spout.

Gasoline power, steam power or electric power.

If there are not many bituminous contracts in your locality now, there may be next year. Why not be prepared for it—why not get the mixer to which you can add hot attachments if you want to contract for hot work?

This advertisement illustrates the Koehring No. 22 on a hot job, re-melting and re-mixing old asphalt. It is ready for all bituminous concrete road mixtures, for street asphalt, rock asphalt and mastic floor work. By detaching hot attachments, and connecting water tank, it is ready for ordinary cement concrete paving

Investigate Koehring automatic operations, and you will see why the Koehring gives greatest yardage—look carefully into Koehring construction and you will learn why the Koehring is the mixer of steady, reliable performance, on job after job, year after year. Write today for full description of the Koehring line, and Koehring construction.



## Koehring Machine Co., Milwaukee, Wis.

# KOEHRING

The "Panama Line"

# General Good Quality Plus—

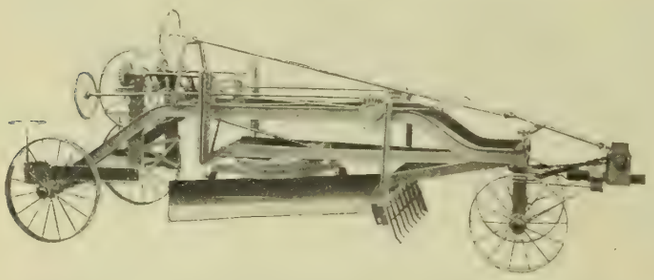
*That Describes the*

## "Panama" Giant

THE "Panama" Giant is a big, sturdy machine embodying all the good points of approved road machines construction and including, as an extra measure of value, certain exclusive features, the value of which are at once apparent.

In general makeup, this machine also includes many refinements which combine to increase its range of usefulness, add to its strength and make its operation easier and more convenient.

Designed primarily for traction use, with strength sufficient to withstand this continued strain and also do its own plowing, the "Panama" Giant is nevertheless so well proportioned in size and weight as to be used with six horses.



### Some "Panama" Giant Features

Here are a few features of the "Panama" Giant Road Machine, the full details of which should be familiar to every road contractor and official.

**Roller Bearings** (exclusive) which reduce the pull 25%.

**Scarifier Attachment** which is so designed as to really give two machines in one.

**Offset Engine Pole** of improved design.

**Single Piece Rear Axle** which can not sag or permit the wheels to get out of line.

These and the many other good points which have brought "Panama" machines pre-eminently to the front are fully explained in "Panama Line" Catalog.

MAIL OR USE FOR MEMORANDUM

The F. B. Zieg Mfg. Co. Fredericktown, Ohio.
Gentlemen:-
Send your catalog as offered in Better Roads and Streets.

Name.....

Address.....

GET THE "PANAMA LINE" CATALOG

THE F. B. ZIEG MFG. COMPANY
*Fredericktown, Ohio*

TELL 'EM YOU SAW IT HERE.

case, is the result to be reported, and is the "co-efficient of cementation."

This important report will be concluded in the April issue of Better Roads and Streets, when, in addition to the remainder of the methods recommended for tests, the forms of record for data concerning the use of non-bituminous highway materials will be presented.

(*To be Concluded in April.*)

* * *

To voice an opinion in interviews with reporters and editorial writers on a subject which admittedly affects a certain class of people or kind of industry, shows at least that a person has the courage of his convictions. But to mix right into the fray, write articles yourself, spend real money and devote your own time and energy in launching a propaganda which is of vital interest to many people and numerous industries, is something which is often talked about but seldom put into actual operation.

Yet, with the approval of his business associates, this is exactly what has been done by S. M. Williams, Sales Manager of the Garford Motor Truck Company, of Lima, Ohio, during the last year or so in calling the attention of all manufacturers of motor trucks and motor cars to the necessity for concerted action and support in the Good Roads Movement.

So thoroughly impressed were Mr. Williams and the other officials of the Garford Motor Truck Company with the importance of this work and its value to their individual interests that they were determined to prove the value of the good roads movement to the other manufacturers of motor driven vehicles.

A questionaire was therefore mailed to every automobile dealer in the United States, requesting information as to the road conditions in each territory and the influence upon both the motor truck and motor car businesses.

To any one who has not given the matter consideration, the replies received from 3,440 legitimate dealers are astonishing, and more so when you realize the little interest manifested by the industry as a whole toward the improvement of such conditions.

The fact that less than ten per cent. of our public roads guarantee the economic or dependable use of the motor car or motor truck should be enough to bring every manufacturer into line, ready to roll up his sleeves and put his shoulder to the wheel to help make the good roads movement a success; especially, when it is understood that the lack of good roads is the barrier which must first be removed before motor driven vehicles can be used to advantage in rural communities.

Mr. Williams has made personal researches in the field as well as by mail in his effort to secure convincing arguments on the good roads movement and this information he has taken the pains and trouble to whip into shape and have distributed in booklet form by the hundreds of thousands of copies. He has also made trips to different parts of the country and given talks on the subject.

He declares that "good roads are an economic necessity; essential to all phases of our commercial and social intercourse and development, and that their favorable influence upon the motor truck and motor car industry will follow as a natural sequence.

"Like selling any commodity with which people are unfamiliar, the success of the good roads movement depends upon educating the public as to its many advantages and convincing them how they, individually, will be benefited."

Appreciating the necessity in a great movement like this, for some one individual or organization with adequate conception of the goal to be attained and the initiative and ability to carry on the work, Mr. Williams points out that "no more powerful influence for good roads could be obtained than the combined efforts of the motor truck and motor car manufacturers, supported by their vast army of distributors and dealers."

More than a year ago, he urged upon the members of the industry, the importance of taking up educational work that would assist in bringing about a better understanding of the subject; of educating those who have heretofore been opposing road improvement on account of a lack of knowledge of its value to themselves and their communities.

While the industry decided against supporting the movement through the National Automobile Chamber of Commerce,

the importance of good roads on the future of the motor truck and motor car businesses is not diminished in the least.

In fact, with production facilities doubled and tripled, the visible demand for motor driven vehicles will soon be filled and then manufacturers will be confronted with the problem of taking care of the enormous output of machines which they are equipped to handle. It, therefore, behooves them to give careful attention to any suggestion which will increase their market.

A new and increased demand for motor trucks and motor cars will keep step with the progress of good roads through the country and the sooner manufacturers realize that it will require much effort on their part to bring about this improvement, and take concerted action to make it possible, the sooner will this tremendous market be available for the distribution of their products.

* * *

## Motor Truck Club of America Activity in Paving Surfaces

For some time past there has been considerable agitation by the trucking interests of New York City regarding the types of surfaces that will be used in the enormous amount of re-paving work that will have to be done this year as the result of the destruction of many miles of streets incident to the new subway construction that is costing hundreds of millions of dollars. The streets of New York are in unprecedentedly bad condition, in fact, they have never been known to be so rough and dangerous. This is not due in any way to neglect of the highway bureaus of the several boroughs through which the new subways pass, but is simply an evil that is made necessary by the difficult construction under way. Who, excepting those who have seen it, can imagine Broadway, America's most famous street, a street surfaced with planks laid cross-wise—in other words, nothing more than the old plank road of our forefathers? This is a fact, however, as several miles of this most important of all thoroughfares is open cut subway work, with the street and street car tracks all supported on shoring while the work of construction is going on below.

On lower Broadway, traffic is very heavy at all times of the year, and thousands of motor trucks and heavy drays carrying loads from five to fifteen tons use this thoroughfare every twenty-four hours, hauling shipments to and from more than two hundred piers, to and from the ferries, railroads, and business houses in Manhattan. As this thoroughfare will have to be practically entirely repaved, there naturally is much interest taken in the type of surfacing material and the thickness of the foundation. Trucking interests are not interested in any way or manner in the material that is to be used, other than to desire that material, laid on a foundation of suitable thickness, that will afford the easiest traction without being so slippery that it would be dangerous. They have had experience with all types of paving, and realize that it is an important matter to them, as many trucking companies and truck owners have learned by experience that very costly accidents are certain to occur on a wet pavement surface that is so smooth that it becomes slippery when fifteen to twenty tons of truck and load start to skid and slide around, absolutely beyond all control of the driver.

At the November meeting of the Motor Truck Club of America, a resolution on the pavement surface of Broadway was passed, and in December the following letter was written by Mr. T. D. Pratt, President of the Motor Truck Club of America to the Hon. Marcus M. Marks, President of the Borough of Manhattan. This letter is clear, and specifically states the attitude of the membership of the most powerful motor truck association in America. The letter is presented herewith in full, as it is of interest to all cities, and to all engineers identified with street paving, as well as to manufacturers of other materials used in street paving.

Mr. Pratt's letter is as follows:

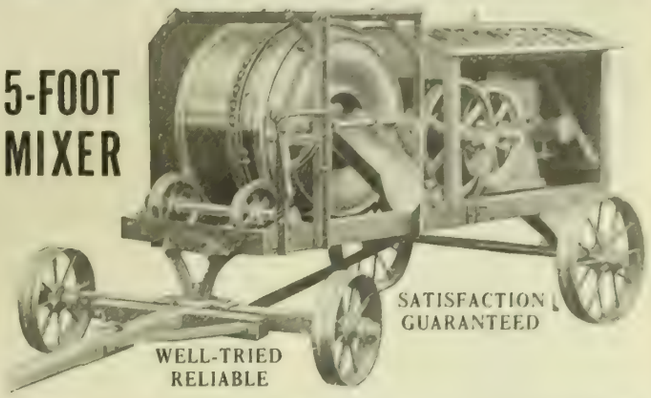
December 11, 1915.

"Honorable Marcus M. Marks,
President, Borough of Manhattan,
Municipal Building, New York City.

"My dear sir: In pursuance of a resolution passed at the last meeting of the Motor Truck Club of America, held in New

"NORTHWESTERN"

5-FOOT MIXER



SATISFACTION GUARANTEED

WELL-TRIED RELIABLE

This mixer is built right—therefore it works right. A 3 H. P. hopper cooled engine, standard wheelbarrow hopper, steel housing and team pole with truck of standard wagon gauge. Weight 2400 pounds. Also made in 10-foot capacity.

NOVO ENGINE furnished at small extra cost, if desired.

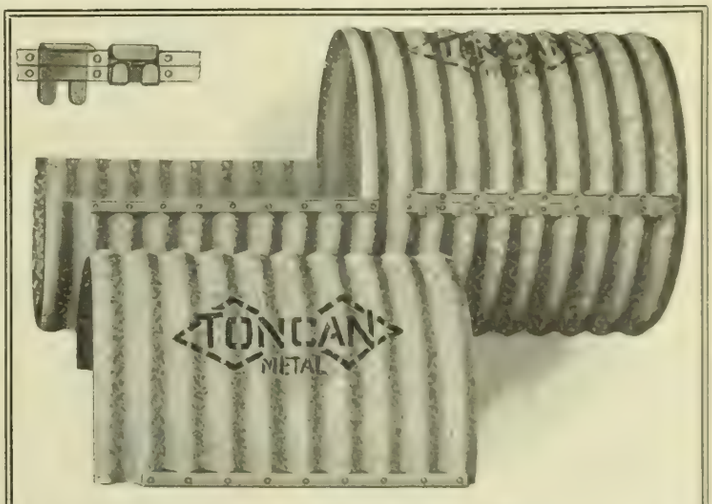
Send for our FREE Book No. 15 on Concrete Mixing, also details of our EASY PAYMENT PLAN.

$185

Built Complete in the Northwestern Factory

Northwestern Steel and Iron Works
Eau Claire, Wisconsin

Capital Stock $200,000.00




*Here's Real Culvert Economy*

The real economical culvert is rust-resisting, non-breakable, easy to transport, install and remove, low in cost and maintenance.

Such a culvert is the

BUTT-JOINT NESTABLE CULVERT

*Made from*

Rust-Resisting TONCAN METAL Anti-Corrosive

SHEETS

Consider carefully the advantages of the Butt-Joint Nestable Toncan Metal Culvert. IT REPRESENTS TRUE ECONOMY.

*Write for Catalog*

THE BUTT-JOINT NESTABLE CULVERT CO.

826-828 REEDY STREET CINCINNATI, OHIO

TELL 'EM YOU SAW IT HERE.




# PROOF!

YOU Road Builders are, or should be interested in culvert construction. The most vital question in road building today is, NOT what type of material to use for the surface of the road, or what make of machinery to do the work—but **the one biggest thing in all road construction is, or ought to be, Drainage!** How to get the most water across the road at the least expense and through the most permanent structure—is a question worthy of the best of you.

A NEW BOOK HAS BEEN WRITTEN ON CULVERT CONSTRUCTION. And this book is FREE to interested readers of Better Roads and Streets. The man who compiled the information contained in it probably knows more about this subject than any man in America today. Yet it is all given to you **free for the asking.** The only request is that you mention that you saw this ad in Better Roads and Streets The book does not confine itself to theories—but is **full of facts and figures.** Even if you do not agree with all that is written—tho that is not likely—you will still find the book full of intense human interest. **It will open your eyes**—if it does no more. This is not a catalog—it is a free BOOK on the subject of CULVERTS. A cut of the outside front cover is shown above. Now get busy with coupon below.

**THIS BOOK FREE**

SALESMEN WANTED FOR

## THE WHALEN FORM

**401 Vinney Building, Syracuse, New York**

**Use Coupon Below at Once and Get Your Copy of This Book Free Today.**

**Fill out and mail today the Coupon below addressed to The Concrete Form Co., Inc., 401 Vinney Bldg., Syracuse, N. Y.**

*Send me at once postpaid, and with no charge or obligation, a copy of your new Culvert Book*

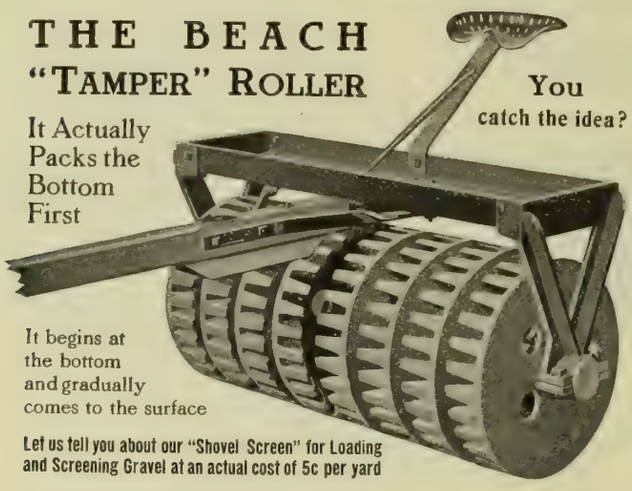
*Name* _____ *Business or Official Title* _____

*Address* _____

## THE BEACH "TAMPER" ROLLER

You catch the idea?

It Actually Packs the Bottom First



It begins at the bottom and gradually comes to the surface

**Let us tell you about our "Shovel Screen" for Loading and Screening Gravel at an actual cost of 5c per yard**

**Beach Mfg. Co., 30 Beach St., Charlotte, Mich.**


York City on November 17, 1915, it is desired to go on record as being in favor of granite block pavement on lower Broadway. It appears to us that the prime factor for consideration is the character of traffic which is going to use this street. This section of Broadway is entirely commercial; there are no theatres or hotels in it. The street is not used by pleasure vehicles to any extent, it is business, business, business—and business to-day means heavy trucking wherever there are warehouses and stores. Heavy trucking means two and three-horse trucks, carrying up to ten tons, and motor trucks, which however, rarely exceed five tons load capacity. Traffic of this character cannot be economically moved over anything but hard-surfaced smooth pavements. Experience in New York City has demonstrated that there is but one, and only one, hard surface which will stand up under heavy traffic long enough to justify the expense of laying it, and that is granite block. Experience has also shown that no pavement surface of any character whatsoever will remain smooth and even for long, even under light city traffic, unless there is a solid foundation under it.

"These statements are all acknowledged facts, and are not submitted as arguments.

"As one exhaustive proof of this, I refer you to the reports of the committees appointed by the late Mayor Gaynor, which were submitted in the early part of the year 1912. They are undoubtedly in your files, and in all probability, you are thoroughly familiar with them.

"In this connection it would seem proper to state that there is only one way to lay a pavement on lower Broadway that will meet the demands which will be placed upon it, and that is by laying an eight or ten-inch concrete foundation—reinforced if the soil beneath is soft. On top of this, about one-half to one inch of gravel or fine stone, mixed with a soft mortar of cement and sand, and the paving block laid immediately upon the placing of this material. The blocks then to be grouted with cement grout and all interstices completely filled. A pavement of this character presupposes paving block of the hardest granite obtainable, each section laid with block of uniform size with the smoothest faces obtainable. When a pavement such as outlined is properly laid—and proper laying is only a question of competent specifications and inspection—the city will have a street which will last indefinitely. This pavement will be in first-class condition when most of us who are concerned with the laying of it have passed out, and the cost of repairs will be almost nothing.

"We wish to urge upon you with all the power which we possess, that for the good of the city and the citizens thereof who will have to use this street that absolutely no other type of pavement be considered for this section.

"It is an old adage, but still true, that 'the best is always the cheapest.'

"What we have said here applies not only to lower Broadway, but to the pavement of all main arteries of traffic, whether north and south, or east and west.


## WANTED

**Ten to Twenty-Five Thousand Dollars, to push the manufacture of road machinery. Been in operation for seven years, put out 800 machines last season. If you have money and brains I have a place for both at the top price. If I can't show you 35% on your investment, don't touch it. If you are situated to take advantage of this opportunity write me—but don't write for curiosity, as I am busy.**

**Road Builder care Better Roads and Streets.**

## WANTED

Second-Hand 24" Gauge Locomotive from 5 to 6 tons service weight. Koppel engines preferred. Also dump cars and portable track, 24" gauge. Also want to purchase Second-Hand Locomotives, 9x14 and 10x16, provided they are in good working condition.

Address

A. J. BRADY, Canton, Ohio




## 100 YEARS ON DUTY

Just imagine standing out in the rain, sleet, snow, cold and sunshine for 100 years—just think of having stones and bricks thrown at you now and then for amusement.

It takes a strong constitution to withstand such abuse and remain on duty every minute of the time for 100 years—but




# INDESTRUCTIBLE SIGNS

**"The Signs That Outlive Father Time"**




are built to stand all this treatment. The fact is—tests have proven them practically indestructible.

**Read what the Cincinnati Automobile Club, Cincinnati, Ohio, has to say of our signs:**

"We have your letter of November 10th, with inquiry in regard to the signs which you have furnished us for the last two years, and in reply would say that we are perfectly satisfied with the signs. We erected, I believe, seventy-four of these signs last year and when they were checked in the middle of the summer we found them in excellent condition, absolutely without rust or corrosion of any kind. We also found that they had withstood shot gun and rifle fire.

We have had a great deal of favorable comment on our new signs and, of course, will continue to use them in the future."

*Send for Our Booklet and Testimonials.*

## The Indestructible Sign Company

**528 Denison Avenue, Columbus, Ohio**

# "Specify Buckeye Berea"

—you can't go wrong in curbing if it's "Buckeye Berea"—lasts longer than the pavement it serves and can then be turned over and relaid at slight expense. Samples, rough or machine dressed, on request.



## "Buckeye Berea" Curbing

will outwear any curbing made of any other material many taxpayers think they are saving money on! Some curbs really *cost more* than you *pay* for them!! True curbing economy is purely a matter of value, not of "first price." It's not what you pay but what you get for what you pay! But make sure it's "Buckeye Berea"—the standard by which all others are judged!!

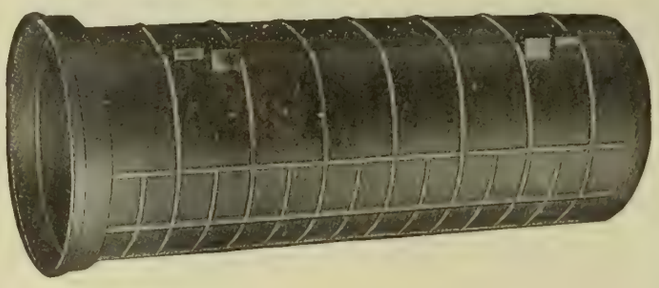
## The Ohio Quarries Co.

**CLEVELAND, OHIO.**

# SAVE TIME—SAVE MONEY

USE THE

## Burch Expansion Cast Iron Culvert Pipe



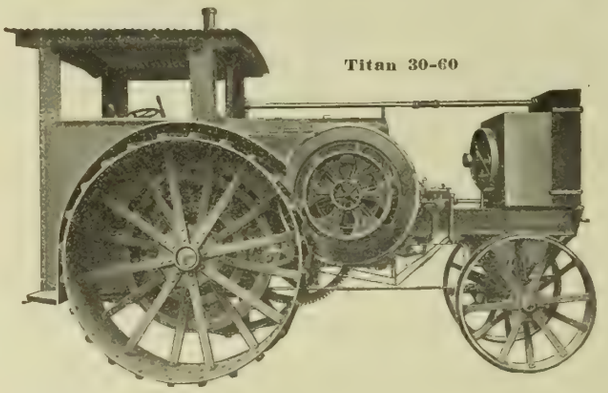
8 to 48 inches diameter, 3 and 4 ft. lengths. Half sections which lock with lugs.

Provides for expansion and contraction. Easy to handle and lay in ditch. Requires less excavation. Strong and durable. Send for Catalog "F" giving full description of complete line.

## THE BURCH PLOW WORKS CO.

CRESTLINE, OHIO

# Kerosene Power Cheapest for Road Work




How much more money would you make for yourself or for your community if you found a way to cut 25 per cent. off your present cost of grading roads? If you are still using horse or mule power, we can show you a way to save even more than that. If you are using a gasoline tractor, we can still show you how to make a profitable saving.

Every dollar you cut the cost of road grading is a dollar added to your net profit. We can put you in touch with one man who says he cut the cost of road grading in Louisiana from $26.00 PER MILE with mule power to $4.50 PER MILE with MOGUL kerosene tractor power. His figures are in the official records of his parish.

That is probably an extreme case, but the fact that so large a saving as this could be made, is interesting. It suggests that possibly your costs are higher than they need be. Perhaps a little investigation would pay. Would you like to see some of the figures we have collected—some of the savings we have helped other contractors and road builders to make by changing over to MOGUL or TITAN kerosene tractor power? They'll cost nothing but a two cent stamp and a little time. Write for them.

## International Harvester Company of America

(Incorporated)

152 Harvester Building CHICAGO, U. S. A.

TELL 'EM YOU SAW IT HERE.


"We trust that this communication will meet the consideration that the needs of the situation demand, and take this opportunity of placing the services of the Motor Truck Company of America, Inc., at your command to help you accomplish the desired result—and that is strong, hard, smooth pavements suitable for heavy traffic.

"With every assurance of our desire to co-operate with you in your desire to serve the citizens of New York, we are

Yours very truly,

"THE MOTOR TRUCK CLUB OF AMERICA, INC.

(Signed) T. D. Pratt, President."

Active co-operation and interest of the kind set forth in the foregoing letter of the Motor Truck Club of America is the kind that will prove to be of inestimable value in every one of our larger cities in this country. The motor truck has come to stay, is rapidly supplanting the horse, and will continue to do so at an even more rapid rate than during the past two or three years. Capacities and loads will be increased, and pavements will have to be built accordingly. Surfacing is a matter that will have to be worked out for each locality in each individual city, as what would be adequate on the heaviest traffic street in Atlanta would be entirely inadequate on lower Broadway and, in fact, almost every other street in New York City south of Astor Place. Why not all co-operate to secure better street pavements?

* * *

## Corrugated Pipe in Road Drainage

By John H. Benton

During the past ten years, a form of road drain has come into quite general use which, prior to that time, was confined to certain localities, and indeed considered somewhat experimental. In practically every State of the Union, and in many foreign countries, thousands of these culverts are carrying the water of intersecting streams or assisting in the drainage of low and marshy areas. The very general custom of providing corrugated culverts with concrete or stone end-walls, no doubt explains the fact that so many people look upon this form of pipe as an innovation, and are surprised to learn of its very extensive use. In riding along a highway or railroad where the intersecting water courses are largely cared for by means of corrugated pipes, it may readily happen that the ordinary observer is wholly unconscious of this fact, since what he sees are the end-walls of what appear from above to be concrete or masonry structures.

On the whole, it must be considered that corrugated pipe has given a good account of itself. This statement is made in full knowledge of the fact that large numbers of corrugated pipe have failed and that in certain regions the highway officials cannot be induced to further experiment with what they regard as an inferior construction. The central idea of the corrugated pipe is the immense gain in strength, which is secured by means of corrugating a smooth plate of metal. It has not been definitely established what is the ratio of gain in strength by means of the standard corrugations one-half inch in depth and approximately two and two-thirds inches in width, but experience has demonstrated that well-made corrugated pipe of the standard gauges (sixteen gauge for the smallest pipes, fourteen and twelve gauge for the medium sizes, and ten gauge for the largest) will, when properly installed with a reasonable depth of covering, successfully carry the weight of the fill and of any load that travels the highway. The term "well made" includes the employment of the proper size and number of rivets. On the longitudinal seams these should occur in every corrugation on the smaller sizes, and there should be two in each corrugation in the larger sizes. Circumferential seams should have rivets not more than eight inches apart. The joints which occur every two feet should be lapped one full corrugation. It is a curious fact that in this form of pipe the joints are actually the strongest portions.

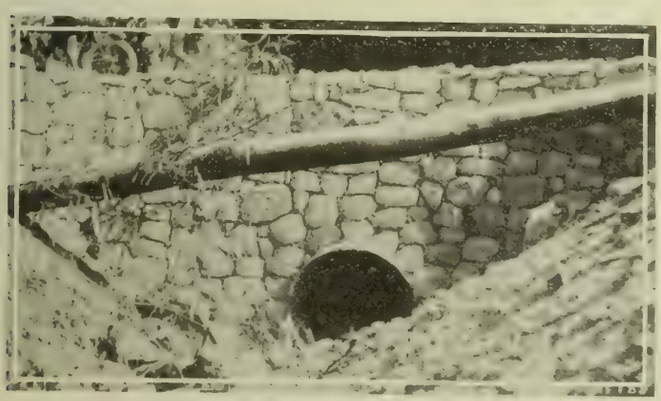
The greatest mechanical advantage of corrugated pipe lies in its ability to conform itself to a shifting or settling foundation, and to endure the strains incident to freezing and thawing without rupture. There is a certain elasticity which comes from the corrugated form and the overlapping joints, which is exceedingly useful under the rough and ready conditions of the highway, where it is often impossible to secure a bed for

a culvert which will remain perfectly level and immovable. The shifting and settling of new fills and the movements of the road foundation resulting from freezing and thawing, seem to have little or no effect on this kind of a road drain, whereas it is well known that these causes are fatal to large numbers of otherwise excellent culverts.



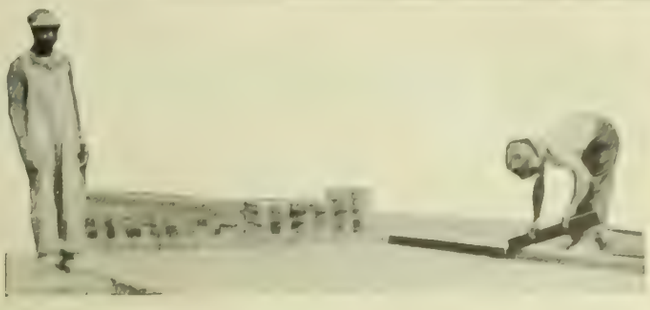
**A 7-foot diameter pipe under heavy fill on a western logging railroad**

Probably the greater part of such dissatisfaction as does exist with regard to corrugated pipe, comes from the employment of cheap and unsuitable material. Exhaustive investigations by prominent metallurgists of Europe and America have demonstrated the fact that the principal cause of corrosion in iron or steel is the impurities or foreign substances which it contains. Reduced to plain language, the explanation is that such substances as carbon, copper, sulphur, etc., act as the negative poles of tiny electric batteries, which are formed in the presence of air and moisture, and that the action of these batteries, like that of all other galvanic cells, results in the progressive destruction of the positive elements. The positive poles in this case are the areas of relatively pure iron. This process brings into existence the little pits and moulds which are characteristic of a rusted steel surface. It follows that a



**Corrugated pipe, 4-foot diameter, under an East Indian roadway.**

practical method for reducing rusting to a minimum is by eliminating these foreign substances as completely as possible; in other words, attaining high purity. Iron made upon this principle has demonstrated in service its ability to resist weather and soil conditions far more successfully than ordinary material, and it is undoubtedly due to the adoption of high purity iron by the most progressive manufacturers of corrugated

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**Uniform from Sand Cushion to Surface**

ELASTITE makes an absolutely uniform joint because it is formed as accurately as the paving brick. When it is set against the curb one edge rests on the sand cushion and the other edge is on the exact level of the pavement.
When the paving expands the pressure is distributed uniformly. There is no weak spot.

A sample will be sent on request.

*WRITE*

**THE PHILIP CAREY COMPANY**

**14 Wayne Avenue, Lockland** **Cincinnati, Ohio**

# WHAT SHOULD A MILE OF GOOD ROAD COST?

Users of "New Huber" Road Rollers have been mailing us some interesting figures lately, showing the cost of road-making with our equipment.

These reports would surprise some folks who think road-making is costly—yet it's a fact, proved by the experience of our customers in many sections, that

**"New Huber" Rollers Build Roads That Stay at Lowest Expense**

—sometimes for less than $30.00 per mile.

*Abundant power, great fuel economy, and freedom from repair bills are only a few of the "New Huber" advantages that our customers' letters talk about—and we get reports frequently.*



Why not get the facts for yourself? You can do it, entirely without obligation, by writing

THE HUBER MFG. CO.

*Road Rollers and Scarifiers, Gas Tractors, Steam Engines, Threshing Machines, Etc.*

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MARION, - OHIO

# Build Macadam Roads

The macadam road is gaining favor each day.

It is the oldest and best class of road construction in Europe and America.

Thousands of dollars are being spent annually to promote Brick and Concrete Roads, BUT BEAR IN MIND THAT A BRICK ROAD COSTS MORE THAN TWICE AS MUCH AS MACADAM and Concrete increases the cost nearly one-half and neither will wear any longer than a high standard Macadam Road.

Figure the total cost of each road covering a period of twenty years or longer and you will adopt macadam.

Get the facts before adopting your specifications.

Write us for information on stone and slag macadam, water-bound, or treated with asphalt or tar.

We can make delivery of crushed stone or slag in all parts of Northern Ohio, Eastern Ohio, Northern Indiana, and Southern Michigan.

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Plant your trees in blasted soil,—the tried and proven way endorsed by the leading orchardists and nurserymen of the country.

Stop first-year losses by setting your trees this spring as described in Handbook of Explosives, No. 360-F.

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culverts that this form of road drain is now in general and successful use.

Corrugated pipe will stand more mechanical abuse than almost any other form of road culvert. and this fact no doubt accounts for its very often being installed as if nothing in the world could ever break or injure it. It is true that it does not require skilled labor or careful supervision for its effective placing, but it is not true that corrugated pipe can be made to serve as a pavement. Observation of some of the pipes laid in various portions of Ohio, with practically no covering at all, would lead to the supposition that it was intended for this purpose. The culverts should have not less than six inches of well-packed covering and, of course, this depth should be considerably increased for the larger pipes. In installing a corrugated culvert, it is necessary to see that the bottom of the ditch is fairly level and free from stones. Stones should not form a portion of the fill immediately around the pipe itself. It is very essential that the filling material should be thoroughly tamped well above the middle of the pipe. If this is done and the other simple measures taken, which are dictated by common sense, an installation of pure iron corrugated pipe may be depended on for long and effective service.

* * *

## "Northwestern" Concrete Mixer

The five-foot mixer, made by the Northwestern Steel & Iron Works, Eau Claire, Wis., which is advertised in this issue, will be of interest to many of our readers.

No big, radically new features are brought out, but old and proven principles of mixer construction have been united with new "wrinkles" to produce a machine which is claimed to give exceptional value for the price—$185. The Northwestern people are patting themselves on the back for being far-sighted enough to purchase all the raw material entering in to the construction of these mixers before the advances in prices took place. This has enabled them to maintain the same base of price which was in vogue for 1915, directly benefiting every buyer of their concrete mixers. A review of the principal features of this mixer is worth while.

*Semi-Convex Discharge Drum.* This eliminates the pockets behind the buckets and drum head, giving the contents of the drum an extra turn as they are thrust against the drum head by the action of the paddles, buckets, etc., diverting them back to the paddles at the charging end. As the ends of the buckets conform to the convex drum head, the concrete is all dumped, making cleaning easier.

*Drum Track.* This is exceptionally wide. Both track and roller are surface-chilled to a depth of ⅛ inch, and condensed beyond this for ¼ inch. The Northwestern people say that they have tried out this feature in actual work for the past three years and that these chilled surfaces wear like tempered steel.

*Counterbalanced Drum.* The drum is chain driven. The sprocket is in five sections, bolted to drum shell and placed at a point midway between center of drum shell and discharge drum head. This location of sprocket registers the center of weight and the application of power at this point counterbalances the drum, eliminating both side play and end motion, requiring less horsepower.

*Unique Side Loader.* The Northwestern people are adopting a very unique side loading attachment, applying particularly to the friction clutches, brakes, etc. It is unusual to find a mixer manufacturer adopting ideas of the biggest machine tool designers in the country, but this is what they have done in the application of the hoist and brake, mounting this on one shaft and operating through shifting castings mounted on rods. It is very compact, positive, and powerful. The parts are all accessible and easily reached for quick repairs. This method is a little more expensive, but the greater efficiency is so marked that the extra expense is more than justified. The engine housing is so arranged that gearing is completely covered, complying with all "safety first" regulations.

The standard gauge wagon track and the very heavy construction of the truck frame, are both worth more than passing notice. The frame is made of $^5/_{16}$ x 2 x 3-inch angle, with hot riveted cross-sections and corner brackets.

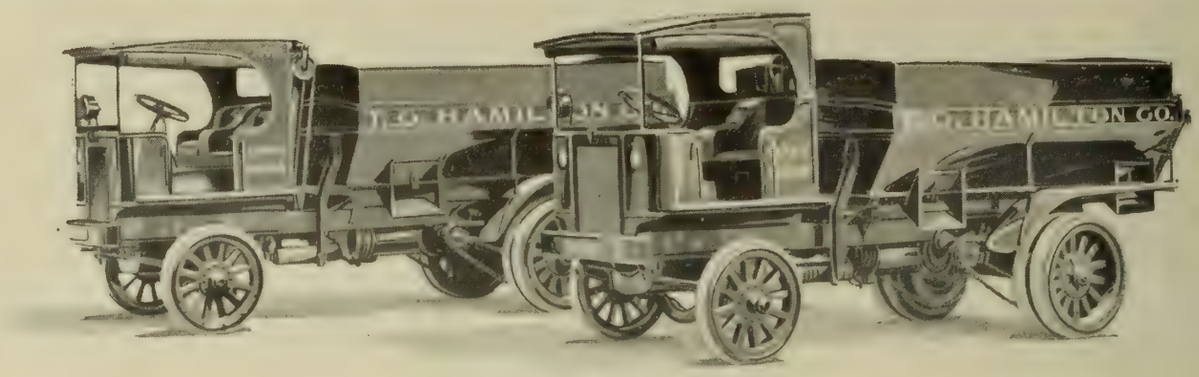
This mixer is also built with a 10-foot capacity, and both sizes will carry a twenty per cent. overload. Contractors will do well to investigate the merits of these mixers before buying.

OF THE
UNIVERSITY OF ILLINOIS

# BETTER ROADS AND STREETS



APRIL, 1916



# Solid Evidence of Superiority

The heaviest purchasers of Garford motor trucks are firms whose systems of cost accounting are most searching and most accurate.

Necessarily the decisions of such firms are based solely on the solid evidence of superiority.

The following letter from the T. G. Hamilton Company of La Porte shows the remarkable economy with which they are operating the two Garford trucks in their service:

*We are pleased to submit the following results obtained with the operation of our Garford trucks, engaged upon highway construction in La Porte County, Indiana, during the past season, and based upon the yard mile and ton mile of stone hauled over earth roads.*

| | *Yard Mile* | *Ton Mile* |
|---|---|---|
| *Gasoline* | *0.18 gal.* | *0.144 gal.* |
| *Oil* | *0.0038 "* | *0.003 "* |
| *Cup Grease* | *0.017 lbs.* | *0.0136 lbs.* |

*These figures are deduced from the total amount of stone hauled, the total amount of gas and oil used, and the distance between the loading point and dumping point, and therefore include the gas and oil required by the return trip.*

The Hamilton Company is one of many road contractors operating Garford Motor Trucks with great success.

Road builders—contactors of all kinds—all over the country find Gafords reliable and economical hauling mediums for all materials.

There is a Garford for *you*. Whether your business is big or little, we can supply you with a Garford Motor Truck that will do your work in just the way you want it done.

Garford

**¾, 1, 1½, 2, 3½, 5 and 6 ton capacity**

## Garford Motor Truck Co., Lima, Ohio

Engineering Library

# Better Roads and Streets

VOL. VI. NO. 4 APRIL, 1916 PRICE FIFTEEN CENTS

## The Maintenance and Repair of New York State Highways

By Fred W. Sarr, Second Deputy, New York Commission of Highways

THE New York State Highway Law provides for the maintenance and repair of the highways of the State as follows: "The maintenance and repair of improved State and county highways in towns, incorporated villages, and cities of the third class, exclusive, however, of the cost of maintenance and repairing bridges having a span of five feet or over, shall be under the direct supervision and control of the Commissioner of Highways, and he shall be responsible therefor. Such maintenance and repair may be done in the discretion of the Commissioner, either directly by the Department of Highways or by contract awarded to the lowest responsible bidder at a public letting after due advertisement, and under such rules and regulations as the Commissioner of Highways may prescribe. The Commissioner of Highways shall also have the power to adopt such system as may seem expedient so that each section of such highways shall be under constant observation, and be effectively and economically preserved, maintained, and repaired. The Commissioner of Highways shall have the power to purchase materials for such maintenance and repairs, except where such work is done by contract, and contract for the delivery thereof at convenient intervals along such highways."

On April 1, 1915, there were improved and accepted, 5,345 miles of State and county highways. This mileage was increased as the season advanced, and on December 31, 1915, there were 5,926 miles of approved and accepted highways, which have been maintained under the above quoted authority.

The following is a summary of the work performed under the aforesaid authority during the past season, including sums obligated on uncompleted contracts:

| | |
|---|---|
| 276 miles of highway resurfaced or reconstructed, at an average cost of approximately $5,471 per mile; total expenditures and obligations under this item | $1,510,112 |
| 2,086 miles of highway given a surface treatment of bituminous material and cover of sand, fine gravel, iron ore tailings, or fine crushed stone, at an average cost of $419 per mile, total expenditures and obligations under this item | 874,137 |
| 728 patrolmen employed in the work of maintenance and minor repairs, at a total cost for labor | 403,047 |
| Expended for material and temporary labor in making miscellaneous repairs and supplying material to patrolmen for maintenance | 998,462 |
| Expendid for rentals of large units of repair equipment | 58,135 |
| Expended for purchase of equipment and tools | 31,958 |
| Expended for engineering, supervision, inspection, and expenses incidental thereto | 334,724 |
| Total amount expended and obligated for all purposes, approximately | $4,210,575 |

The provisions of the section of the Highway Law permitting performance of the maintenance and repair of improved highways, either by contract or by departmental forces, would seem to indicate, as the intent of the law, that all work which could be properly anticipated and foreseen should be incorporated into contracts which should be awarded to the lowest responsible bidder, and that emergency work and work of a minor nature, particularly such repairs as cannot be definitely measured or expressed in contract units, should be performed by departmental forces.

It has been the policy of this administration to carry out this interpretation of the intent of the law to such an extent as the urgent expediency of the performance of the particular work would permit. The following contracts were prepared, advertised, and awarded to the lowest responsible bidder:

| | |
|---|---|
| 84 contracts for reconstruction and resurfacing 263 miles of highway, at an aggregate cost of | $1,383,273.00 |
| 84 contracts for furnishing the materials and applying surface treatment of bituminous material and cover to 1,346 miles of highway, at an aggregate cost of | 551,265.00 |
| 3 contracts for extraordinary work in the construction of retaining walls, at an aggregate cost of | 11,146.40 |
| 20 contracts for the furnishing and delivering of bituminous materials for the use of patrolmen and other departmental forces, aggregating | 238,831.19 |
| 39 contracts for the furnishing and delivering of crushed stone for the use of patrolmen and other repartmental forces, aggregating | 92,051.00 |
| Total number of contracts awarded, 230; aggregating the sum of | $2,271,566.59 |

There was expended directly by the department for materials, labor, rentals, and the purchase of equipment and tools, the sum of $1,604,285.00.

A study of this department in maintaining and repairing highways during the past year indicates that the expenditures are divided into three groups, as follows:

1. Maintenance, or the act of maintaining and preserving the various features of the highway in the same or uniform condition; the cost of such maintenance of all the improved highways of all types was approximately $350 per mile, which includes the cost of the patrol system and the material used by the patrolmen, together with the cost of the surface treatments with bituminous materials and cover and supervision.

2. Repair, or the act of restoring the highway to its former condition after more or less extensive deterioration during the winter season with the contingent freezing, thawing, unstable foundation, obstructed drainage, floods, washouts, sliding banks, etc., and that the cost of such emergency repairs was approximately $140 per mile for roads of all types.

3. Reconstruction and resurfacing. While on many of the improved highways it appears possible, with efficient maintenance, to preserve a standard of improvement from year to year, there are those that show marked deterioration in spite of efforts at maintenance and extensive repairs from time to time. This deterioration is generally due to peculiar traffic conditions, combined with unsuitable materials used in the original improvements, and is often the result of insufficient foundation over unstable material in the roadbed.

In cases where the traffic is heavy and the crushed rock used for constructing the top course is of the softer varieties, this course is worn away in a few years and it becomes necessary to resurface the macadam with a new top or wearing course; and in cases where the foundation is unstable, the thin surface breaks through in the spring of the year and it is often necessary to reconstruct the entire pavement on a heavy stone foundation. In a few instances, adjacent to large cities, where the traffic is congested and resurfacing has been necessary at frequent intervals and the maintenance has been costly and unsatisfactory, it has been demonstrated that economy demanded a reconstruction of the entire pavement with a more expensive and permanent type.

During the past year the mileage of resurfacing and reconstruction has averaged about five per cent. of the total mileage of improved highways, at an average cost of about $5,500 per mile, for the mileage treated in this manner, or a charge of about $260 per mile when distributed over the entire improved mileage.

The total amount expended and obligated for all purposes in the year will average $750 per mile when distributed over the entire mileage of improved highways.

This statement is misleading in that a large percentage of the total improved mileage is of recent construction.

The first highways improved by the State under the Higbie-Armstrong Act were completed in 1899, and in thirteen years, or at the end of 1911, there had been completed and accepted but about 2,600 miles, while in the last four years there have been completed and accepted 3,226 miles. In other words, fifty-five per cent. of the improved mileage has been constructed in an average of two years, while the forty-five per cent. has been improved in an average of ten years.

Assuming that no pavements should require resurfacing for a period of four years after construction, it is necessary to eliminate the 3,226 miles which have been improved during the past four years from the consideration of the cost per mile for resurfacing and reconstruction. Therefore, the total expenditure for this subdivision of the work should be distributed only on such mileage as has been constructed or improved for a period of four years, and when so distributed, the cost per mile for this subdivision during the past year is approximately $560 per mile.

It would seem, however, that the average life of a pavement after reconstruction would be greater than that of the first improvement, as foundational weakness that had developed would be provided for in the reconstruction. Also the maintenance and repairs for the first five years after the original improvement are greatly increased by heavy items which are properly chargeable to improvement, and are really a completion of the improvement, such as removal of slides from banks which have been cut into at the time of improvement; the construction of retaining walls to sustain such banks and for the protection of the highway from the erosion of streams. The drainage conditions, as provided in the original improvement, are often the subject of much complaint from the abutting owners, and necessitate modifications and construction of storm water sewers, all of which develop and are taken care of in the first few years after the original improvement. It can, therefore, reasonably be expected that the cost of maintenance repairs and reconstruction will decrease in some proportion to the age of the improvement and that the high cost of $560 per mile for resurfacing and reconstruction, when applied to all the improved highways, would never be attained, and that the reduction in the item of repair would offset the increase in reconstruction as the improvements increased in age, owing to the gradual elimination of weakness, together with the effect of efficient maintenance.

It would accordingly seem by this manner of reasoning that the improved State and county highways of all types could be perpetually maintained for about $750 per mile.

The expenditures of the maintenance bureau for the past year have been segregated into groups to determine the expense of maintaining the roads of various types, the expenditures in each instance being charged to the type in which the highway was classed at the beginning of the season or before reconstruction.

There were under maintenance during the season of 1915, a total of 192 miles of gravel roads, upon which the average expenditure, including reconstruction to a different type, was $955 per mile, and the average expenditure, exclusive of reconstruction, was $577 per mile. Gravel roads, while most susceptible to deterioration under heavy traffic, are most easily and readily repaired. Said repairs are generally accomplished by scraping and honing in the spring and the addition of new material from gravel banks in the vicinity.

Surface treatments have been given to gravel roads, but are not generally satisfactory where any considerable traffic prevails. The treated gravel surface is soon converted into longitudinal ruts and ridges by displacement, and this condition is not as easily repaired after the surface has been treated. Where medium to heavy traffic prevails, it appears preferable to lay a new macadam surface over the existing gravel, and this practice for the past season results in the heavy expense for reconstruction of this type.

There were under maintenance during the past season 2,298 miles of so-called water-bound macadam highways, upon which the average expenditure, including resurfacing and reconstruction, was $1,055 per mile, and the average expenditure, exclusive of resurfacing and reconstruction, was $564 per mile. The expenditures on this type of pavement are larger than on any other type, for maintenance and reconstruction. This is partially due to the fact that the average age of this type is greater than that of any other type. The maintenance is more expensive owing to the necessity of more frequent surface treatments and to the necessity of constant patching. The large charge for resurfacing is due to the large number of miles of pavement resurfaced, and not to the cost per mile of the highways thus treated.

There were under maintenance during the past season, 2,387 miles of bituminous macadam penetration method pavement, upon which the average expenditure, including resurfacing and reconstruction, was $510 per mile, and the average expenditure, exclusive of resurfacing and reconstruction, was $448 per mile. A much larger percentage of this type of macadam is located on the main trunk lines than that of the water-bound macadam, and, in general, the motor vehicle traffic over this type is very much larger, in spite of which fact the maintenance is less than for the water-bound macadam pavement.

Of the bituminous macadam, mixing method type, there were under maintenance sixty-three miles during the past season, upon which the average expenditure for maintenance was $181 per mile.

The expenditures on highways of this type during the past season have, in general, been for labor on the shoulders and gutters and for other work outside the permanent pavement proper, although in a few instances it was necessary to do considerable patching to the pavement, but, in general, little or no repairs were required to the pavements.

The most unsatisfactory type of pavement, from the maintenance standpoint, is that of the concrete bituminous type, and the construction of this type has now been abandoned by the New York State Commission of Highways. The body of this pavement is formed of a low grade of cement concrete which was given a light surface treatment of bituminous material and fine stone chips at the time of construction. This thin surface treatment does not adhere to the concrete, is readily removed by traffic, which then wears into the concrete, necessitating frequent and constant patching. Numerous experiments have been tried out with surface treatment of varying depths, and the consensus of opinion of those who have endeavored to maintain this class of pavement is that any surfacing, to be satisfactory, must be thick enough to have stability in itself, and not less than two inches in depth.

There were under maintenance during the past season, 295 miles of this type of pavement, and the average expenditure, including new surfaces, was $1,050 per mile, while the average expenditure, exclusive of resurfacing, was $532 per mile.

There were under maintenance during the past season, 84 miles of first-class concrete pavement, and the average expenditure on this class of highway was $129 per mile. These pavements are of recent construction, the average age being one year, and the expenditures were nearly all for labor and materials on the shoulders and gutters, a small expenditure only being required on the pavement for filling the frost cracks with pitch. From the limited experience in the maintenance of this type of pavement, it would seem that an expression in regard to the efficiency of the type should be reserved for at least another year.

Under the heading of "Block Pavement," have been grouped the expenditures for all brick, stone block, and asphalt block pavements. There were under maintenance during the past season, 291 miles of these types of pavements, and there was an average expenditure on highways of this type, $190 per mile, including the reconstruction of one section of about one-third of a mile in extent. The expenditure for maintenance was $176 per mile. This expenditure is, perhaps, about evenly divided between the pavement and the shoulders. The expense of the maintenance of the shoulders is much heavier with the rigid pavements, such as concrete and block, than with the macadam types. This is due to the smooth, rigid edge which catches and holds the traffic parallel thereto for a short distance, similar to the effect of street car rails. A rut is soon formed along the edge of the pavement, which is generally filled with crushed stone, increasing the cost of shoulder maintenance.

On the older brick pavements there has been expended a considerable amount during the past season for taking up and

relaying small areas that have broken down. In Erie County, wherein is located the greatest mileage of brick pavements, some 102 miles, the average cost of maintenance of this type was $245 per mile.

Summarizing the mileage and the average expenditure for maintenance, repair, and reconstruction per mile per year for each of the different types, we have the following:

193 miles of gravel roads cost $955 per mile.

2,298 miles of water-bound macadam roads cost $1,055 per mile.

2,387 miles of bituminous macadam, penetration method roads, cost $510 per mile.

63 miles of bituminous macadam, mixing method roads, cost $181 per mile.

295 miles of concrete bituminous roads cost $1,050 per mile.

84 miles of first-class concrete roads cost $129 per mile.

291 miles of block pavement roads cost $190 per mile.

5,611 miles of all types cost $750 per mile.

A review of the above summary would indicate that the various types could be grouped into three classes, namely, low, medium, and high maintenance types, and when so grouped we have 438 miles of low maintenance type, including bituminous macadam, mixing method, first-class concrete and block pavement, upon which the average expenditure for maintenance was but $177 per mile per year; 2,387 miles of medium maintenance type, including bituminous macadam, penetration method, upon which the average expenditure was $510 per mile per year; and 2,786 miles of high maintenance type, including gravel, water-bound macadam and concrete bituminous, upon which the average expenditure was $1,059 per mile per year.

If the low and medium maintenance types are grouped in one class, we have slightly over one-half of the improved highways, upon which the expenditure for maintenance is about $440 per mile per year, and slightly under one-half the total mileage upon which the expenditure for maintenance and repairs was $1,060 per mile per year.

It is contended that with the present system of maintenance, in many cases the life of a pavement may be extended indefinitely. The method referred to is that of treating the surface of the pavement with a light application of asphaltic oil or refined tar, and a cover of fine crushed stone, sand, or gravel. This treatment consists of spraying on the surface of the pavement about one-quarter of a gallon of oil or tar, and covering the same with from ten to fifteen pounds of cover material per square yard of pavement. These materials are worked and kneaded into the existing pavement by the traffic, and most efficiently by rubber-tired traffic, and results in filling up the small interstices between the larger fragments of the existing pavement, and increasing the thickness of the pavement from an eighth to a quarter of an inch. This increase in thickness should more than offset the constant wearing away of the surface by the abrasion caused by the pounding of the iron-shod feet of the horses and iron-tired vehicles. The repetition of this treatment from year to year will gradually increase the thickness of the existing pavement. The ideal condition is where this treatment approximately maintains the pavement at its original thickness, as it has been found that where the treatment has been too heavy or too frequently applied and the oil and stone mat is built up to a greater thickness than one-half inch, it is liable to creep and to become displaced by traffic, particularly in hot weather.

The experience of the Department in New York State would indicate that a water-bound macadam pavement under the average condition of rubber-tired traffic, should be treated once each year for two years, then perhaps the treatment should be omitted the third year, and in subsequent years, the treatment is required two years out of three.

With the penetration type of bituminous macadam, a surface treatment is not generally required until the second or third year after improvement, and thereafter, a treatment every second or third year. The advantage of this type of treatment is the ability to thereby incorporate a thin layer of new material with the existing pavement at a minimum cost and restore, at more or less frequent intervals, the part which has been worn away by traffic. The necessity for this type of treatment is entirely chargeable to the fast-moving, rubber-tired vehicles. Before the advent of the automobile, an artificial binder of bituminous material was not necessary.

The horse-drawn, iron-tired traffic tends by the impact of the horses' feet and the grinding of the iron tires under a heavy load, to break up any particles of loose stone on the surface, crowding the smaller particles down into and uniting the same with the pavement in wet weather, and at all times maintaining a mat of fine particles, silted and bound together by moisture, forming a protective carpet over the larger fragments.

The fast-moving, rubber-tired traffic tends to remove all dust and fine particles from the surface and from the interstices between the larger fragments of the pavement until they become loosened and a hole starts, which rapidly spreads until the entire top course is soon thrown to the side of the road.

The first observed effect of automobile traffic on the macadam roads of New York State was observed commencing about 1903, and was the clean and bare appearance of the macadam, the larger fragments of the crushed stone being exposed to view. It was then necessary, from time to time, to sprinkle over the surface of the macadam a light layer of sand or stone chips to relieve the rough condition of the surface, which was disagreeable to traffic of light, horse-drawn vehicles.

Where there was a considerable amount of horse-drawn, iron-tired vehicle traffic, which would wear away the surface and provide an amount of fine material to offset that removed by the motor vehicle traffic, the surface would remain smooth under the combination of traffic, which would, however, rapidly wear away the top course, decreasing the thickness of the pavement as much as one-half inch per year, thereby necessitating resurfacing the pavement with a new top course in from three to five years.

As the motor-vehicle traffic increased, it became necessary to cover the surface of the macadam with a light layer of sand or fine crushed stone at frequent intervals during the summer season, and in 1907 and 1908, several sections of highway were given surface treatments of bituminous material and stone chips as an experiment. In 1909, when the Maintenance Bureau of the New York State Highway Department was organized, bituminous surface treatments came into general use, and last season, about 2,086 miles were thus treated.

Numerous grades of bituminous products have been tried out with varying results, the grade of the material representing the percentage and the hardness of the bitumen residue contained in the product. The most efficient material seems to be one that carries 65 to 70 per centum of bitumen or pitch, and which can be applied in a spray under pressure at a temperature of from 80 to 100 degrees, Fahrenheit. This grade of material is sufficiently liquid for several days after being applied that it may be worked and kneaded into the porous surface of the pavement by the rubber-tired traffic.

A heavier material that requires heating to a temperature higher than 130 degrees, Fahrenheit, in order that it may be applied, cools after application and before receiving traffic, and assumes a consistency of rubber gum, and while it may be united with the stone chips by rolling, it cannot be as thoroughly worked into the body of the pavement, and simply lies on the surface as a mat which shifts around under traffic, and is then worked into waves and hollows. An example of the principle is the painting and varnishing of wood surfaces. A thin paint or varnish is applied and is worked into the pores of the wood by brushing and rubbing, so that a more desirable surface is obtained than by using a heavier or thicker varnish, applied by pouring the same on the wood surface. The varnish being so heavy, it is necessary to heat the material to make it sufficiently liquid to be poured over the surface. No one would expect such a finish to a hardwood floor to be very desirable or lasting. The floor could be opened to use very much quicker, but permanent results would not be expected. This simile is set forth as an explanation for the necessity of the disagreeable condition of the road surface for a few days after the bituminous treatment is applied, during which period the traffic is working and kneading the more or less liquid material into the existing pavement.

There is also the necessity for the use of the light material in the subsequent treatments, in that the light carrier oils soften the hardened material of the former treatments and permit the new material to unite and combine therewith.

The best results are also obtained where the least amount of cover material permissible is used. This can best be explained by comparing the bituminous material to Portland

(Continued on page 60.)

# A Glutrin Bound Macadam Road

By C. J. Knisely, Chief Engineer of the Glutrin Paving Company, Columbus, Ohio

THE object of building a public highway is to provide a convenient means of travel for persons and vehicles between various points; to furnish a surface on which the force of traction will be reduced to a minimum, and over which vehicles may pass with safety and expedition at all seasons of the year; to secure a covering that will preserve the natural soil from the effects of moisture and to support the vehicles by distributing the weight over a larger area of the sub-grade.

In selecting a type of pavement it is necessary to take in the factors which enter into an ideal pavement and the physical and mechanical agencies which tend to wear and disintegrate the pavement. "The most important physical agencies are frost, the attrition of falling rain, the transporting power of water, and the action of the wind. The mechanical agencies are abrasion, impact, compression, and shear."

A perfect highway should be as nearly dustless as possible, readily shed water, noiseless, durable, hard enough to prevent its being cut up by heavily-loaded wagons, resilient enough to afford a foothold for and prevent injury to horses, moderate in first cost, easy and rapid to construct, repair, and maintain, smooth but not slippery, easily cleaned, agreeable to the eye, radiate but little heat, adapted to every grade, suitable to all classes of traffic, and offer the least possible resistance to traction. It should be practically level and as straight as the contour of the country will permit, of proper width and cross section.

To combine all of these qualifications is often a difficult matter and with some types of pavement it is impossible. There should be a good and definite reason for every element entering into the design and construction of a road or pavement. The standard of all pavements is continually growing higher and the public more exacting and expecting better service. The intelligent use of any material in construction depends to a great extent, upon the knowledge and skill possessed by the user, regarding the characteristics of the materials and methods of construction.

The ideal binder and preservative for a macadam road is some cementing material that will bind the aggregate firmly together, that will render the metal practically waterproof, form a stable surface and yet not destroy the elasticity and resilience of the mass. A binder that will protect the surface from the disrupting strains to which the road is likely to be subjected and at the same time will be reasonably low in first cost and economical to maintain.

To build roads which are permanent is impossible, and to attempt to do so is economically unwise. The alignment, grade, earthwork, drainage, culverts, and bridges of certain kinds, may be regarded as permanent, but most of these will not remain permanent unless protected by a proper wearing surface.

There is no such thing as a permanent road surface. Traffic and distintegration from natural causes render any road surface subject to repair or renewal at some time or other, and adequate provision should be made for such repair and renewals as the same may become necessary.

There is a special application of the laws which govern the growth of interest upon money and which will be valuable to the engineer who desires to estimate correctly the comparative merits and economy of different types of pavement. Some of these types may be cheaper than others, in first cost, but their life may be shorter or the annual expense of maintaining them, greater. In other types the first cost may be great or excessive, which again renders the annual cost of maintenance great, due to the annual interest charge upon the difference in cost of the two types of pavements. This annual interest charge may be greater than the annual cost of the maintenance of the cheaper type.

The engineer should determine, if possible, what type of pavement will be most economical in the long run. The truest economy does not necessarily lie in the choice of the plan of least first cost, or even of greatest first cost. The element of time must enter into our calculation as well as the first cost of the pavement. In selecting a type of pavement the aim should be to give the public the maximum of benefits with the money available and make the improvement extensive rather than intensive.

Most engineers are too prone to building expensive roads. They like to see what they term a finished product. This is a frequent fault and usually results in poor economy in highway construction. In highways, as in railroads, we should consider this economic principal—that it is better to make an entire country accessible by building a more universal means of communication and then letting the added prosperity maintain this, up to the standard, than to leave part of it inaccessible by building only a limited number of miles of extravagant construction.

The financing of road improvements is rapidly becoming of vast importance. It necessarily involves consideration of all future operations of construction, repair and maintenance, and the repair and maintenance charges should be considered at the time of selecting the type of pavement.

The average difference between the cost of a brick road and a glutrin-bound macadam road is something over ten thousand dollars per mile. It does not matter whether the money is obtained from a bond issue or is the result of a tax levy. The money is worth five per cent. per annum, and it should be so calculated from the time the bonds are issued or the money is collected for an almost indefinite period. The interest on ten thousand dollars, the difference in cost, at five per cent., is five hundred dollars per year. The average cost for maintenance of a glutrin road should not exceed two hundred and fifty dollars per mile per year. Figuring on this basis at five per cent. interest for a twenty-year period, we would have a difference of fifteen thousand dollars in cash. But even if it cost five hundred dollars per mile per year to maintain the macadam road, we would have at the end of twenty years, ten thousand in money, and an excellent macadam road, or, a worn-out brick road that cost ten thousand dollars per mile more to construct and which will then cost ten thousand dollars per mile to resurface, because no maintenance has been provided. In the design of a road the engineer should consider the kind, nature, and action of the forces or elements which tend to disrupt or disintegrate the road surface and then select those materials and methods of construction, consistent with economy, which will best serve to counteract those forces.

The first essential is good and thorough drainage. The second is in having a firm, smooth, compacted road bed. The road should be constructed in two courses. The lower course being designed to assist in distributing the loads over a larger area of the subgrade and to support the wearing surface.

Clays and most sub-soils, when thoroughly saturated with moisture, become very slippery. Therefore, if a roadbed is not properly drained and the voids are not thoroughly filled, the traffic on a road will force the clay up through the stone, which will act as a lubricant between the various particles of stone, and the bearing or supporting value of the road will be destroyed. When a road surface is weak from an insufficient thickness or from a soft or yielding foundation, bending and cross breaking takes place under passing loads which breaks the bonds between the stone.

The upper course should be designed to withstand the action of the elements and the wear and tear of traffic. The durability of a road surface depends upon the power of the materials of which it is composed, to resist those natural and artificial forces which tend to destroy it. The life and stability of a macadam road surface, to resist the action of traffic, depends largely on the interlocking of the pieces of stone and the retention of the fine particles of dust and screenings which serve to bind together and hold in place, the coarser particles of stone constituting the road surface. The more perfect the keying and interlocking of the stone, and the binding of the dust and screenings, the more rigidity. This must be accomplished by either chemical or mechanical means, or both, other-

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wise there is no bonding of the materials forming the road surface.

In the construction of a glutrin bound road it is very essential that all the voids be thoroughly filled with screenings and fine dust as the fine particles and screenings very materially assist in holding the larger fragments in place, and are also more readily acted upon by glutrin.

If the voids are not thoroughly filled when the glutrin is applied, the road will act like a sieve and the glutrin will filter through it before there is any action or set produced by the glutrin. Glutrin produces a firm, hard surface but has sufcient resilience and elasticity to withstand the strains without cracking, due to changes in temperature.

There are in general use four different methods of binding the stone, which forms the road surface. The first consists in keying and interlocking the stone by rolling and adding dust or screenings and flushing them into the voids. This forms a mechanical bond which assists in holding the pieces of stone in place.

The second consists in adding to the stone or aggregate, a binder such as bitumen, the resulting bond being due to the adhesive action of the bitumen itself. The third consists of forming a bond between the various particles of aggregate by adding a material such as Portland cement. When water is added to Portland cement the active element of the Portland cement immediately goes into solution, after which a precipitate is formed, consisting of crystals which in hardening, adhere to the various fragments, thus binding them together.

The precipitate which forms and hardens is the result of a chemical union between the cement and water, for the cement alone will not harden, unless moisture is added to it, nor has water itself any cementitious or binding properties.

The fourth consists in using a material such as glutrin, which combines all three of the foregoing methods. Glutrin takes advantage of the mechanical action due to the interlocking of the stone, and also has an adhesive action similar to that of tar or asphalt, and a binding action like that obtained by the use of Portland cement.

"It has long been known that simple moisture has the effect of leaching out of road materials, certain natural binders, chemically effecting a union between the particles of stone. A bond is developed by hydrolizing some of the rock components which results in the formation of colloids. Water containing small amounts of carbonic, humus, or other acids, is capable of slowly decomposing many minerals, commonly found in rocks used in road building. Water alone is capable of acting chemically upon many rock constituents, causing a breaking down into secondary products of the primary minerals."

This is the principal underlying waterbound road construction and sets up what is known as the bond of a road. The chemical action acts in binding the road surface by the formation through solution and evaporation of crystal bodies, which, upon crystallization, forms a more or less rigid bond.

The effect of glutrin is to intensify this leaching and hydrolizing action thereby greatly increasing the quantity and quality of the natural binder brought out of the road metal.

When glutrin is added to a road surface which is composed of limestone, silica, and alumina, an action similar to that of Portland cement takes place, although its action is slower, producing a series of chemical compounds which flow out into the space between the stone and crystallize in very much the same manner as cement, forming a bond which is insoluble in water and which is not affected by changes in temperature.

Glutrin is not the only substance that acts chemically when applied to a road surface, as "Sodium silicate, commonly known as water glass, and having the formula, $Na_2SiO_3$ which, upon exposure to the air or to carbonic acid gas, gelatinous silicic acid is precipitated from its solution, which, when applied with some basic material, such as limestone, makes an excellent binding material. Sodium silicate may be applied in solution. From solutions of metallic salts, sodium silicate precipitates insoluble colloidal silicates of the metals."

The life of a glutrin road is dependent largely upon the aggregate used and the methods employed in the construction. As long as there is moisture present, the production of the chemical bond continues and when the road becomes dry the bonding medium created by the action of glutrin hardens and becomes insoluble. The voids thus become so sealed that the surface thereafter absorbs but very little moisture. The adhesive action is intensified thereby obviating all raveling of the road surface which greatly reduces the wear upon the road because of the hardness and density of the mass which it produces. Some binders produce a very rigid bond, and others a more or less resilient bond. The latter is to be preferred for country highways.

Another point to be considered in the selection of a road surface for country highways is that the traffic confines itself to about three-fourths of the width of the road. Where the traffic is heavy or concentrated there is a marked tendency for bituminous macadam of the penetration type to squeeze out, forming broad depressions, holes and ruts, owing to the bitumen possessing very little inherent strength within itself to resist shear and compression. These depressions will eventually become deep enough to collect debris and hold water, which will hasten the deterioration of the road. On city and village streets this tendency is not so great as the traffic must necessarily be well distributed over the surface and in a diagonal direction because of the constant passing of the various vehicles.

The problems involved in the construction and maintenance of country highways, therefore, differ very materially from those which are encountered in the improvement and maintenance of city streets. Hence the materials and methods of construction which have proven satisfactory for city and village streets, often prove dismal failures in country highway construction.

The object of a surface treatment is to prevent the formation of dust, the loss of the fine particles, and the displacement of the coarse aggregate. A clean, practically dustless surface is the first prerequisite of any form of surface treatment, since it is not the purpose of a surface treatment to lay any quantity of dust which may be present on the road, but to prevent the formation of dust.

Many so-called road binders are essentially lubricants, and when put on a road surface in any considerable amount, will disintegrate the road surface instead of binding it. It is very desirable and important that the surfacing material penetrate the surface of the road to a small extent.

A difficulty with most surface treatments is that they form a mat or carpet coat on the road surface which does not adhere to the road metal. This mat soon breaks and peals off and instead of protecting the road surface, is a serious detriment or damage to it, as the traffic produces a hammering effect upon the road metal where the mat has been displaced, causing deep holes and ruts.

It is generally conceded that asphalt is best for surface treatment for bituminous roads. This is best evidenced by the action of the American Society of Municipal Improvements at their convention, held in Dayton in October last, when they by their action recommended an asphalt surface for all types of bituminous road construction, whether the bonding material be of asphalt, tar, or other bituminous product.

A serious objection to most binders by the penetration method is that in cold weather they become brittle and slippery, while in warm weather the road loses much of its stability, due to the plastic condition of the bitumen and to the fact that the voids are mostly filled with bitumen instead of screenings and fine graduated material.

Usually the best results have been obtained by the application of cold asphalt treatments. It is advisable to wet the road and let it set until thoroughly dry before the application. This cleans the stone, thereby removing any film of dust and also makes the surface slightly porous, the resulting moisture induces capillary attraction and offers a better chance for the bituminous material to penetrate and adhere to the road surface.

On roads where the product of wear and dust formation is reduced to a minimum the road may become dusty from outside sources, as no road surface will remain dustless for any considerable length of time.

The ideal road surface for cities and villages is a macadam road bound with glutrin, treated with a light asphalt. The glutrin binds the aggregate together, forming a very stable surface. The asphalt combines with the glutrin, forming a chemical or mechanical mixture, insoluble in water and which produces a dustless surface that will not crack, break, or peel off.

(Continued on page 62.)

# Thirteenth Annual Convention of the American Road Builders' Association

FROM the standpoint of attendance, there is no question but that the Thirteenth Annual Convention of the American Road Builders' Association was an unqualified success. Over 2,500 members, delegates, and visitors were registered during the week of the meetings, which were held in Machinery Hall, Pittsburgh, Pennsylvania, February 28 to March 3, inclusive. There were official delegates present from twenty-seven States, three provinces of the Dominion of Canada, Russia, and the Canal Zone, Panama. There were also an unusually large number of officials and representatives of road machinery, road materials, and other companies interested in and identified with, in one way or another, the problems of road improvement, maintenance, and repair.

The convention hall was cold during the first few sessions, occasioning much real complaint, and causing many colds. The management also received much criticism through an oversight in the decorations, as the Canadian flag had been omitted, in spite of the fact that it was well known that there would be a large number of delegates and visitors present from the Dominion. The Canadians were not at all pleased when they noted this upon entering Machinery Hall, and much comment and complaint was made against this lack of courtesy. The matter was taken up at once in strong terms by the Pittsburgh daily papers, which expressed themselves in no uncertain terms. The oversight, thus called to the attention of the officials of the American Road Builders' Association and the Pittsburgh Chamber of Commerce, was quickly remedied, and this time, without the despatching of "notes" by official Washington, trouble was averted, the Canadian flag flying where it belonged, with our own.

There were but twelve papers on the program this year, the program containing a number of new subjects, as well as some new authors. A general discussion was opened following the reading of each paper, it having been decided this year to have the discussion opened by an authority who was selected by the Program Committee. The plan worked out very well, and as a general thing, the discussions were of more than ordinary interest, and brought forth lively tilts on several occasions.

No sessions were held during the day on Monday, the time having been given over to the registration of the delegates and visitors and the securing of hotel accommodations, which were at a premimum, as every hotel in the city was crowded.

A public meeting was held on Monday evening at Soldiers' Memorial Hall, which was packed to overflowing. The Hon. James Francis Burke, of Pittsburgh, was chairman of this meeting, with Congressman Dorsey W. Shackleford, Chairman of the Good Roads Committee of the House of Representatives, as the principal speaker. Congressman Shackleford delivered one of his usual excellent addresses and took the meeting by storm. After speaking of the greatness of Pittsburgh, he took up the subject of good roads as related to the preparedness of our country, the following extracts being taken from his address:

"And while I am talking of good roads, I might say something of preparedness. I am for an adequate preparedness. You ask, what can be termed adequate? That depends upon the use you wish to put it to. The popular interest in national defense, now, is due to the lessons we have witnessed of late and which we do not fully understand. This question has been forced upon the world by the mighty spectacle of the efficiency of the Germans—and I say that without any comment upon their aims or ideals. But most of us have not read that lesson aright.

"Why is the German thundering to-night at the gates of Verdun with every prospect of attaining a victory there? Some people say because he has been systematically trained for years. But look at the German before he took to the trenches; he was leading the world in chemistry, in productiveness, in trade, in philosophy, in countless fields. He was prepared for physical efficiency, for moral efficiency, for mental efficiency—every man and woman of him was prepared. Give our men this physical and mental and moral preparedness, place them on a sound footing and develop them individually to the highest attainable points and they also will lead the world; be prepared for anything that is to come. To give this preparedness we must make this nation not merely isolated villages and towns and cities, but unify it into one great nation that speaks one thought, that has a common ideal. Yes, we must have guns and mines and torpedoes and coast defenses, but before all else, we must see that the individual ability reaches its highest level.

"A Frenchman will tell you that had it not been for the splendid French road system, Paris would have been ransacked long ago. The Germans will tell you that had it not been for his great roads he would never have attained the successes he has.

"I do not believe that America is in danger of war, but if she ever engages in any war, it will only be of serious import because of a tremendous combination of nations opposing her. If that time comes, we will not win on the high seas, we must fight with our coast defenses, with armies, with air fleets. And in the meantime, we must live within our own borders. That seems a big problem, but if our country is developed as it should be, we would be able to live and maintain ourselves in this country for fifty years.

"In this good roads movement we wish to build up sections and make them of great productivity by uniting them more closely with the world by means of great highways. We cannot do this without adding to your wealth and to your opportunity of adding great selling fields to your present patronage."

Ex-State Highway Commissioner Edward M. Bigelow was the next speaker, and in speaking of the roads of Pennsylvania, urged that some concerted effort be made to have the legislature provide money for the construction and maintenance of the highways of the State. In talking of his own experience as State Highway Commissioner, Mr. Bigelow said:

"I started out right. They promised me fifty million dollars to start with, but some people thought I was going to steal it all, so I didn't get it. Still, experts say, it will cost two hundred million dollars to build up the 10,200 miles of road that the State of Pennsylvania has taken over in the last four years. I believe bond issues the best manner of furnishing the necessary funds for the construction of roads but we will not be able to build any roads in Pennsylvania for five years unless by the imposing of a tax on land."

In concluding, Mr. Bigelow spoke of the millions of dollars that have been expended in Allegheny County, of which Pittsburgh is the county seat, in the construction and maintenance of a remarkable road system, and that this system has been built by a special road tax without burdening any one, as the section is a very rich one.

Hon. Philander C. Knox, Ex-Secretary of State, was the next speaker, and delivered an execellent road talk that made a tremendous hit with the big audience. He told of his troubles in trying to have passed in the Senate and the House of Representatives a bill authorizing the construction of a Lincoln Way from the White House to the Gettysburg battlefield, commenting as follows:

"I cannot fancy that any man who thinks at all of the purposes for which this congress is being held in Pittsburgh, can be out of sympathy for it. Did you ever find anybody who could give an intelligent objection to good roads? Did you ever know anything so perpetual and so enduring a a good road? A road, built because the people needed it, is as permanent as a river."

Mayor Jospeh G. Armstrong, of Pittsburgh, stated that he would like to suggest that some means be found of having the State return to the cities some of the revenue derived from the licensing of motor vehicles.

Governor Eliott W. Major, of Missouri, stated in his address that he had come up from the lowly farm on which he worked in his boyhood days to the position of chief executive of the State of Missouri, and that in all this time he has never ceased preaching the gospel of good roads, a gospel which he

stated, he had learned while young, from hard and practical experience. The building of roads, he stated, marks the epochs of a nation's progress. He urged the using of the inventive genius of the twentieth century by the adoption of the use of modern and up-to-date road machinery and equipment in the building, maintenance, and repair of roads. He told of how the building of roadways into a country district develops that district and makes it more valuable and of greater service and value to the people, not only of that particular district, but of adjoining and other districts. He sang the praise of the old earth roads, of which he stated there is such a large mileage in his State, and without which the great highways that are being built would have no feeders, which would mean that the country districts would remain undeveloped. He said our scientific road builders could go on indefinitely building splendid trunk roads across the country, but that until the mud road of the farmer was put in proper condition, the very kernel of the good roads propaganda will be missed.

On Tuesday morning there were meetings of the various committees of the American Road Builders' Association, followed by the opening session of the convention at eleven o'clock with Col. Edwin A. Stevens, president of the American Road Builders' Association, and Commissioner of Public Roads of the State of New Jersey, in the chair. This session, as were all the business sessions following, was held in the convention hall, at the exposition grounds. Colonel Stevens introduced Mayor Armstrong, who welcomed the delegates and visitors on behalf of the city of Pittsburgh. The State of Pennsylvania then welcomed the body through T. R. McDowell, road superintendent of Chester County, who represented Governor Brumbaugh, it having been impossible for the governor to be present. County Commissioner Addison C. Gumbert welcomed them for the county of Allegheny, following which Joseph W. Hunter, First Deputy Highway Commissioner of Pennsylvania, delivered a brief address, inviting the delegates to make every use of the roads. The Pittsburgh Chamber of Commerce welcomed the delegates through its president, D. P. Black.

Colonel Stevens responded for the American Road Builders' Association, his talk being brief but right to the point. Governor Elliott W. Major, of Missouri, then made another address, stating that he has been in favor of good roads since the time when he was a boy and worked on the dirt roads of Pike County, Missouri, where he was born. It is worthy of mention that Governor Major has been indorsed by the Democrats of Missouri as the choice of that State for the Vice Presidency at the coming Democratic National Convention.

The afternoon session was scheduled for 2:30, with two subjects on the program. The first of these was "Railway Track Construction in Paved Streets," by R. Keith Compton, Chairman and Consulting Engineer of the Paving Commission of Baltimore, Maryland, which was read by the author and discussed by many authorities, including H. W. Durham, County Engineer of Bergen County, Hackensack, N. J.; J. M. Larned, Engineer of Way of the Pittsburgh Railways Company, Pittsburgh, Pa.; Gordon Campbell, President and General Manager of the York Railways Company, York, Pa.; J. Toner Barr, of the Pittsburgh Chamber of Commerce; E. B. Ulrich, City Engineer of Reading, Pa.; W. M. Kinney, Inspecting Engineer of the Universal Portland Cement Company, Chicago, and several others. W. H. Taylor, Jr., City Engineer of Norfolk, Va., who was scheduled to lead the discussion, was not present.

The second paper was, "The Control of Openings in Pavements," by Norman S. Sprague, Chief Engineer of the Bureau of Engineering, Pittsburgh, who was not present, so his paper was read by title. The paper was discussed by George E. Datesman, Director of the Department of Public Works, Philadelphia, and Henry Welles Durham, County Engineer of Bergen County, Hackensack, N. J.

Following the discussion of this paper, Colonel Stevens appointed the following Committee on Resolutions: George W. Tillson, New York City, Chairman; Charles Whiting Baker, New York City; Major W. W. Crosby, Baltimore, Md.; F. E. Everett, State Highway Commissioner of New Hampshire, Concord, N. H.; W. A. McLean, Deputy Minister of Highways of the Province of Ontario, Toronto, Ontario, Canada; Fred E. Ellis, Melrose, Mass.; James J. MacDonald, Ex-State Highway Commissioner of Connecticut, New Haven, Conn.; W. D. Uhler, Chief Engineer of the Pennsylvania State Highway Department, Harrisburg, Pa., and R. L. Morrison, of Texas.

No session was scheduled for Tuesday evening, as the delegates and visitors were invited to a theater party at the Nixon Theater to see a specially arranged performance of "Rio Grande," which appeared that week for the first time on any stage. The officers of the American Road Builders' Association and the members of the local Pittsburgh committees occupied boxes. At the conclusion of the performance, Augustus Thomas, author of the production, appeared before the audience and made a speech which contained many favorable allusions to the good roads movement and the work of the delegates. The theater party was given by the Pittsburgh local committee and the Pittsburgh Chamber of Commerce.

It was late when the Wednesday morning session was called to order, but it was one of the best sessions of the entire meeting. W. D. Uhler, Chief Engineer of the Pennsylvania State Highway Department, presented an excellent paper on "Recent Developments in the Building of Concrete Roads," following which there was a general, and at times, quite heated discussion of the subject. Mr. Uhler told of numerous experiments that have been undertaken by his department in an effort to secure a better type of concrete pavement than is generally being laid at the present time. He told of the various thicknesses of slab and mixes that are being used, and gave some interesting details regarding the construction of the Bethlehem-Allentown-Easton road started last year by his department. It had been anticipated that there would be a lively time when the general discussion of Mr. Uhler's subject was reached, and both the friends and the foes of the concrete pavement were on hand in full force, prepared to down their adversaries if occasion presented. The fireworks went up on scheduled time, too, the fuse being touched off when Professor H. B. Shattuck, of the Railroad Engineering Department of Pennsylvania State College, Bellefonte, Pa., made the statement that it had been positively found that concrete sidewalks are a failure, and that the same objection which he applied to concrete sidewalks could rightly be made against roads or highways of similar construction. Professor Shattuck asked the convention to consider changes in highway construction so that a lasting road could be secured. It is, he stated, a serious problem in small towns, to secure a good concrete sidewalk, and even more of a problem to secure a good and lasting concrete road. Then there ensued a heated debate between the advocates of the concrete road and the advocates of various other types of road. The advantages of the concrete road were brought out by the one side, while its flaws were brought out equally strongly by the other side. J. T. Harrop, Supervisor of Roads of Bergen County, N. J., said that he had laid a concrete road according to the latest and most approved practice in his county, and that it had lasted but one year before it practically went to pieces. Numerous others who had had trouble with this type of roadway related the experiences that they had had during and following construction. The representatives of the Cement Association and of the various cement manufacturers were very much in evidence during the discussion, and in turn showed the convention facts and figures concerning some concrete roads that had been constructed in different parts of the country. W. M. Kinney, Inspecting Engineer of the Universal Portland Cement Company, Chicago, stated that he thought that the life of a properly built concrete road should be about twenty years, but brought forth a hearty laugh when he stated that in his opinion the life should be a hundred years. To this statement, Chairman Dean added, "That is, if there is no traffic on it."

Several of those present attempted on several occasions to get definite and specific statements from the adherents of the concrete road as to just what life might be expected from it by those laying it. With the exception of the statement made by Mr. Kinney, however, no one seemed willing to make a statement that would become a matter of record in the proceedings of the Association. There were, however, many facts and figures produced showing the life to date of pavements in all parts of the country, some of these having been laid many years ago. The discussion was easily the most interesting of the entire meeting, and among those who engaged

in it on one side or the other were, H. B. Shattuck, Assistant Professor of Railroad Engineering at Pennsylvania State College, Bellefonte, Pa.; R. L. Morrison, Professor of Highway Engineering at the Agricultural and Mechanical College of Texas; Anthony Bowen, Mayor of Fairmont, W. Va.; K. H. Talbot, Assistant Inspecting Engineer of the Universal Portland Cement Company, Pittsburgh, Pa.; Harvey Linton, Altoona, Pa.; B. Woodyard, Parkersburg, W. Va.; C. H. Roper, President of the Omaha, Lincoln & Denver Highway, Lincoln, Neb.; W. M. Kinney, Inspecting Engineer of the Universal Portland Cement Company, Chicago, Illinois.; John T. Harrop, Supervisor of Roads, Bergen, County, Hackensack, N. J.; A. T. Chollar, of the Atlas Portland Cement Company, New York City; T. J. Jones, City Engineer of Brantford, Ontario, Canada; Charles Whiting Baker, New York City; William M. Acheson, Division Engineer of the New York State Highway Department, Rochester, N. Y.; F. W. Patterson, Cleveland Trinidad Company, Cleveland, Ohio; James H. MacDonald, Ex-State Highway Commissioner of Connecticut, Robert A. Meeker, State Highway Engineer of New Jersey, Trenton, N. J., and many others. The discussion had been so long that it was necessary to postpone the balance of the program until the afternoon session.

This session was called to order by Colonel Stevens, who introduced John H. Gordon, a prominent contractor of Albany, New York, and President of the New York State Road Contractors' Association, who presented an excellent paper on "A Contractor's Suggestions to Engineers and Inspectors." This is a subject that has seldom been brought up before our road meetings, and contained much sound common sense that would make road construction a much simpler proposition for highway engineers, highway contractors, and inspectors if some of its suggestions were literally carried out to the letter. The discussion of this paper was opened and led by Fred E. Ellis, a prominent paving contractor of Melrose, Mass., whose remarks served to amply strengthen the points brought out in the paper by Mr. Gordon.

"The Adaptability of Paving Materials to Different Conditions and Localities," was the subject of a paper to have been presented by F. C. Pillsbury, Division Engineer of the Massachusetts State Highway Commission, who was not present, and his paper was read by title. The chair then called on Francis P. Smith, of Dow and Smith, Consulting and Testing Highway Engineers, New York City, for a written discussion on the paper. Mr. Pillsbury's paper was a lengthy one, having been prepared in advance, and contained some excellent material, the following being an extract from the paper:

"The necessity of providing for the requirements of traffic is imperative and the materials which will sustain traffic in a hot climate may not answer in a cold climate, and vice versa, although certain materials may be so manufactured and so used that the changes in climate will have little effect on them. While there are certain other requisites such as those related to hygiene and æsthetics, these are not usually necessary requisites, inasmuch as they do not have to be provided for in determining the choice of materials, excepting as secondary considerations. Nearly all first-class pavements can be made sanitary, practically dustless, and reasonably free from mud, and will remain so if properly designed and properly cared for.

"Aesthetic requirements are almost always satisfied by the results obtained from an excellent surface and the surroundings of the road, such as tree planting, roadsides, etc. Noise, however, depends directly upon the kind of traffic and cannot always be easily overcome. Stone pavements can be so constructed and maintained as not to be seriously noisy, and the tendency is toward smoother pavements. Noise is a serious consideration in cities, and should always be avoided as far as possible, but in these days of mechanical vehicles, there seems to be more of an opportunity to overcome noise in the vehicle itself due to the conditions of the vehicle rather than to the condition of the street."

"Roads at Low Cost for Moderate Traffic," was an excellently prepared paper, read by the author, F. E. Everett, State Highway Commissioner of New Hampshire, in which, after he had taken up the work that has been done by his department, he went into detail in some of the essential problems of construction, and particularly maintenance. Mr. Everett plead for a cheaper road, outside of the trunk line roads between large cities and between county seats, in these times of modern road building when large sums of money are being expended for highway improvement, and when any sort of a so-called, but erroneously called, "permanent type of pavement" costs from ten thousand to thirty thousand dollars per mile, and stated that because of the building of so much of this so-called and expensive "permanent" type of pavement, bankruptcy is already threatening certain localities and municipalities, as well as certain highway departments in certain States. He said that the high class type of road is essential for the main arteries of the country, but that a positively cheaper type of road should always be used, regardless of location, for the other kinds of roads. The following quotation is from this paper, and is a direct and well-taken stand in favor of the water-bound macadam and gravel road.

"There is no doubt that the highest types of road are essential to trunk lines or main roads between cities or county seats, and to roads that are subjected to all sorts of traffic from horse-drawn vehicles to heavy motor trucks. But, is it not necessary that a cheaper type of road be constructed outside of those main arteries? Even if a commonwealth can arrange a bond issue ample to construct its whole highway system of bituminous macadam, concrete, or brick pavement, is it not economy for it to construct a less expensive pavement? I say, emphatically, YES."

This paper was discussed at considerable length by Nelson P. Lewis, Chief Engineer of the Board of Estimate and Apportionment of New York City; W. M. Kinney, Chief Inspecting Engineer of the Universal Portland Cement Company, Chicago, Ill.; Arthur W. Dean, Chief Engineer of the Massachusetts State Highway Commission, Boston; Joseph W. Hunter, First Deputy Commissioner of the Pennsylvania State Highway Department, and others.

The session closed with the reading of the paper, "Foundations for Roads and Streets," by the author, Joseph W. Hunter. This paper had been scheduled for Friday, but it was impossible for Mr. Hunter to be at the session on that day, so the paper was advanced. As the hour was then late, there was little discussion other than the clearing up of a few points brought out in the paper.

The annual dinner was held at the Fort Pitt Hotel on Wednesday evening, following which there were a number of talks by officials of the Road Builders' Association, of the city of Pittsburgh, Allegheny County, and the Chamber of Commerce. An entertainment and cabaret show had also been provided.

The Thursday morning session was called to order by Colonel Stevens; H. Eltinge Breed, First Deputy Commissioner of the New York State Commission of Highways being the first on the program, the subject of his paper being "Brick Streets and Roads." There was some little discussion, but the subject had been so thoroughly handled by Mr. Breed that there was nothing new brought out with the exception of some information by William C. Perkins, Chief Engineer of the Dunn Wire-Cut Lug Brick Company on the green concrete base for this type of pavements. Others entering into the discussion of the paper were Major W. W. Crosby, of Baltimore; Fred E. Ellis, Melrose, Mass.; Charles Whiting Baker, of New York City, and W. M. Kinney, of the Universal Portland Cement Company, Chicago.

Charles F. Knowlton, Manager of the Paving Department of the Simpson Brothers Corporation, Boston, Mass., was on the program to read a paper on "Recent Tendencies in Stone Block Pavements," but was not present, and his paper was ordered read by title. The discussion was opened and led by Henry Welles Durham, County Engineer of Bergen County, New Jersey, who, as former Chief Engineer of the Bureau of Highways of Manhattan, New York City, has had a wide and very valuable experience with stone block pavements. Others entering into the discussion were A. T. Rhodes, Superintendent of Streets of Worcester, Mass.; Zenas W. Carter, Secretary of the Granite Paving Block Manufacturers' Association, Major W. W. Crosby, of Baltimore, and E. I. Hannah.

The third and last paper of the session and the day was, "The Function of Stone in the Bituminous Concrete Pavement," by Robert B. Gage, Chief Chemist of the Department of New Jersey, who handled this, another comparatively new

(*Continued on page 62.*)

# Quarrying, Crushing and Screening of Blast Furnace Slag

By George D. Steele

THERE is probably no road material on the market in this country to-day which is attracting more widespread attention from the highway engineer, the highway official, and road builders in general than blast furnace slag. While it is not a new product by any means, having been used in concrete construction as an aggregate for many years, and in the construction of water-bound and bituminous macadam pavements for at least twelve years, up until a few years ago its use was local and not considered commercial by any means. But it proved through practical test that it was deserving of every consideration, and during the past three years has come into quite general use in macadam construction, both in foundation and top course work. Several States have adopted it in the specifications for concrete and macadam construction as an alternate with crushed stone. Notably among these States are New York State and Ohio, both of which are most favorably known for their high-class of work.

It is not the intention in this article to enter to any great extent into the construction of roads or streets in which slag is used in one form or another, but to give some pertinent data on the methods employed in the preparation of slag for this construction.



Figure 1. Front View, Showing Loading Tracks.

Blast furnace slag is now available in many parts of the country, but particularly so in Ohio, Michigan, New York, Pennsylvania, West Virginia, New Jersey, Delaware, and Alabama in the East, as well as in a number of States in the West. In some of these States, or in certain parts of them, there is a marked scarcity of stone suitable for road building unless it is brought from a considerable distance at a considerable cost. Slag is available in many of these sections, blast furnaces being located there, so that the slag can be secured at a cost considerably lower than imported stone could be brought in. It is just such a case that this article will take up, the southwestern part of New York State being the example. This section of New York State comprises two divisions, as determined by the State Highway Commission, and includes what is, excepting only the southeastern part, in which New York City is located, the most traveled part of the State, including such important cities as Buffalo, Rochester, and Syracuse. Stone of a suitable quality is scarce throughout the greater part of these two districts, although there are some few local quarries which produce an excellent quality of stone. The quantity is small, however, and practically all the stone used must be shipped in from a considerable distance.

There are numerous blast furnaces in the vicinity of Buffalo and the Tonawandas, so that there is assurance of an ample supply of slag for highway construction to be secured there to take care of all possible requirements within a radius of several hundred miles, it being generally estimated that there will be a ton of blast furnace slag for every ton of pig iron produced. It is, therefore, natural that some enterprising concern, realizing that there would be a large demand for this product, should locate and construct a large and modern plant in that vicinity.

In the early days of the use of slag for road construction, the material was merely excavated from the slag piles, which were generally two or more years old, and after screening, it was shipped or hauled to the site of the work. Little consideration was given to crushing, the removal of iron and other impurities, and then to proper grading and screening. This is all a necessity in the present day, however, if a concern is going to profitably market its slag, as engineers have been making a careful study of all slags and refuse to sanction the use of many of them for various reasons, such as insufficient aging, water cooling, non-uniformity of structure, and analysis of the material and poor grading.



Figure 2. Side View Showing Incline up which loaded cars are hauled to send Slag through the Plant.

This is just what happened last year near Buffalo, as a plant was built by the Island Slag Company, with offices in Buffalo, and it is this up-to-date and modern plant which will be described in this article, taking the reader through all steps from the quarrying of the slag to the final loading on cars for shipment to all points in western New York State, northern Ohio, western Pennsylvania, and to the Dominion of Canada. First, however, a few words regarding slag and the development of this now important industry will not be out of place.

Blast furnace slag may be properly termed the refuse of the blast furnace, it being generally of a silicious nature, and results from the combination of the earthy and foreign matter contained in the iron ore and the flux, which is usually a limestone, which is used in the reduction of the iron ore to molten iron. There are also some impurities from the fuel, the blast furnaces being charged with alternate layers of coke, iron ore, and limestone. Fresh materials are added from the top of the furnace as the charge works down. The molten iron, being of greater specific gravity than the molten slag, settles to the bottom of the furnace, from which it is drawn off as pig iron. The furnace is also tapped at another higher point, and the slag is run off continuously. It was, in years past, usually used for the reclamation of and the making of additional land around the plant, and for filling in depressions, etc. But in a number of instances this slag, which had cooled into solid masses, was either blasted, dug by hand, or quarried with a steam shovel, and then used on roads and foot-paths or for fill-

ing in with fairly good results. Then later on, when it was realized that the slag would later on be removed from the premises, it was dumped while in a molten state into pits of water. This method of handling granulated the slag and it was, after cooling by this method, loaded into cars and wagons and still used for roads, pathways, and fills. And it can be said that the use of slag was again considered fairly satisfactory.

About nine years ago, it was realized by some of the large producers of crushed stone that the crushing and screening of



Figure 3. View of 5-Yard Marion Steam Shovel.

blast furnace slag would make its uses as numerous as the uses of crushed stone. One of the first, if not really the first of these was the France interests of Toledo, Ohio, so that these interests are pioneers in the development of blast furnace slag. These interests own the plant which will be described in this article, the plant at Harriett, New York, being the fifth that they have erected. The new Harriett plant, which was placed in operation the latter part of last summer, is operated by the Island Slag Company, with offices as already stated, at Buffalo, New York, and is the largest, the most modern, and the most complete of the five slag plants operated by these interests.

The plant was built at the plant of the Wickwire Steel Company but a few miles from Buffalo, where there is a large bank of slag of an excellent quality. This slag bank is approximately semi-eliptical in shape and is about 700 feet long by about 300 feet along the minor axis of the semi-ellipse, this



Figure 4. 5-Yard Marion Steam Shovel, showing size of dipper as compared with a man. This piece of equipment is able to literally "walk through" the slag bank.

axis being an approximately straight line. The average thickness of the slag in this bank is approximately twelve feet in depth on the average. It is of an excellent quality, running on the average about thirty-five per cent. silica, fifteen per cent. alumina, and over forty-one per cent. lime.

A good idea of the appearance of the plant may be gained from the two illustrations shown herewith (see Figures 1 and 2) which show the back and the front of the plant, the way the quarried slag is taken up into the plant and the loading tracks for the finished product. At the top of the incline which will be seen in Figure No. 2, and which is 125 feet long and rising to a height of twenty-five feet, is a spring switch leading from the main track to a side and parallel track, which at a distance of seventy-five feet from the base of the incline, again switches into the main track.

A Marion steam shovel, model 91, with a five-yard dipper has been placed at one end of the minor axis of the semi-ellipitical slag bank, and at the outside of the main curved track. This Marion shovel excavates a pit in the slag bank that is forty feet wide and running to the depth of the slag. The excavated slag is then loaded onto square box, six yard, two way dumping standard gauge Koppel cars, manufactured by the Arthur Koppel Company. These cars have proven particularly efficient and easy to load, as each car takes approximately the entire contents of the five-yard dipper of the Marion shovel, and little material has to be handled the second time through falling over the sides of the cars, as would be the case if the capacity of the cars were the same, or smaller than that of the dipper of the steam shovel. In loading, the shovel continues its excavation in a curved path parallel to the main curve. Then as the excavation of the pouring pit proceeds sufficiently far from the starting point, the molten slag from the blast furnace is poured into the pit again, slowly filling it and permitting of ample time for the slag to cool slowly. In this manner the shovel works on until it comes to the end of its semi-elliptical path, when it is then transferred to its original starting position and follows the first path, re-excavating the same pit which has been refilled with slag as the shovel was moved forward. The time required to



Figure 5. 37-Ton Saddle Tank Standard Gauge Vulcan Locomotive, used to haul trains of Koppel Cars.

make this complete round depends entirely upon the amount of slag that is being prepared and shipped from the plant, but it is so designed that when the plant is running to full capacity, the time required will be not less than two months, thereby guaranteeing that no slag will be shipped that has not been given two months in which to age and cool.

After the steam shovel has excavated the material from the slag bank and loaded on the Koppel cars, five of these six yard cars, loaded each trip, are drawn by a saddle tank, standard gauge, thirty-seven ton Vulcan locomotive (See Figure No. 5.) to the foot of the incline which leads to the top of the crusher plant. The Vulcan locomotive then drops these loaded cars and couples onto five empty cars which have descended the incline to the parallel side track, and returns to the shovel. The arrangement is such that the locomotive is kept in operation all the time, that there are always empty cars at the shovel, loaded cars at the incline and a train of five cars, either loaded or empty on the way from the shovel to the incline, or vice versa.

When the loaded cars reach the incline, they are uncoupled and one by one they are drawn up the incline by a friction hoist which is belted to the main shaft. This main shaft is, in turn, driven by an 80 H. P. 230 volt, alternating current motor, manufactured by the General Electric Company, Schenectady, New York.

When the cars have been elevated to the top of the incline they are automatically dumped into a bin of approximately fifty cubic yards capacity. It will be noted that this bin is of sufficient size to amply provide for the load of two trains,

thereby avoiding delay in case there should be a necessity to stop the crusher for a short time. While the car is still attached to the cable which hauled it up the incline, it is automatically switched to the side and parallel track and then descends the incline to be made up into the empty train to be returned by the locomotive when it brings down the next train of loaded cars.

The fifty-yard bin into which the slag is dumped by the cars feeds the slag onto a canvas conveyor belt four feet in width. The distant pulley of this conveyor over which this belt runs is a solenoid which retains on the belt all the free iron contained in the slag. The iron is retained to a point where it drops into a chute and thence runs to a bin. The slag drops into another chute and is fed into a double revolving screen. This screen is circular in shape and consists of an inner and outer screen. It is made of ⅜-inch steel plates. The outer screen, which is made in three four-foot sections, is ninety-six inches in diameter and twelve feet in length. The inner screen is made in four four-foot sections and is seventy-two inches in diameter and sixteen feet in length. In the outer screen are punched one and one-fourth-inch circular holes, while in the first three sections of the inner screen the holes are one and one-half inches in diameter. The fourth and last section of the inner screen is punched with three and one-half inch holes.

From this well designed and efficient screen, two kinds of material are secured. The first is the slag which is ready to be sized and the other is the slag that has been rejected by the screen. The material from the screens is then fed into three bucket belt conveyors. Two of these conveyors take care of the material ready to be sized, while the third takes care of the rejected material. These belts are all of rubber, manufactured and furnished by the Revere Rubber Company. The belt handling the rejected material is twenty-eight inches in width and carries the rejected material up an incline forty feet in length. The two belts handling the material to be sized are each eighteen inches in width and the inclines are eighty-seven feet in length. The slope on all three of these inclines is one to three.

The material that has been rejected is taken from the top of the conveyor through a chute and directly by gravity into a Gates Number 6 gyratory crusher, where it is again crushed. From this crusher the slag is then conveyed on a canvas trough conveyor twenty-two inches in width back to the revolving sizing screen that has already been described.

The material that has properly passed the screens described and is ready to be sized now leaves the conveyor and is dropped into a chute through which it is carried into another revolving screen which is four feet in diameter and sixteen feet in length. The construction of the screen is similar to that of the first screen. The larger sizes of slag from this second screen are carried through chutes to storage bins, while the smaller sizes are fed onto a shaker screen. The chute feeding to the shaker screen is in reality a gravity screen of 3-16-inch mesh. This screen removes the dust from the small sizes, and all the slag that ranges from dust to that which will pass the 3-16-inch screen is then carried through another chute to a storage bin.

This shaker screen is worthy of particular mention. It consists of a nest of four horizontal screens of different mesh. These four screens are connected to four parallel rocker arms which are inclined to the vertical at an angle of forty-five degrees with the four screens set each fourteen inches apart. The screen is known as the Welch Shaker Screen.

The slag from the shaker screen is then carried through chutes to storage bins, the chute carrying the size known as roofing slag being a gravity screen. The screen is so designed and constructed that it eliminates from the roofing slag all the dust contained therein. This dust is then carried into a separate bin known as the dust storage bin.

From the eight storage bins built in the plant the slag is loaded into the railroad cars. These cars run the tipple, shown in Figure No. 1, by gravity, on two parallel standard gauge tracks. Three trunk line railroads, as well as water shipping facilities, make it possible to ship from this plant the finished product to all points made accessible by the unusual shipping conditions.

The France interests, as already stated, pioneers in the preparation of crushed air cooled blast furnace slag, deserve much credit for the part they have taken in promoting the use of a material that has already become an important factor in road construction, and for the construction of a plant of the modern design such as the one already described. This concern also has several other plants in full operation, and is shipping immense quantities of this material for road construction, railroad ballast, aggregate in all classes of concrete work, roofing materials, the manufacture of concrete blocks, etc. The slag shipped is at all times a clean and evenly-graded material, and is strong, tough, and durable, and the advancement made in its production makes it available for use at a cost that is far from excessive.

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## North Carolina

THE Third Annual Good Roads Institute was held at Chapel Hill, North Carolina, February 7th to 12th, under the auspices of the University of North Carolina, the North Carolina Geological and Economic Survey, and the State Highway Department. Forty-four counties were represented by one hundred and thirty-five delegates within the State and delegates from six other States were registered.

Dr. Joseph Hyde Pratt, State Geologist and Director of the Road Institute, declared himself well pleased with the attendance and with the increasing interest in the work of the Institute shown both among visiting delegates and university students. Dr. Pratt was also delighted at the fact that so large a number of the highway engineers of the State were attending the Institute and were taking an active part in the work. Last year eighty-three men from thirty-two counties attended the Road Institute.

The general topic for discussion was "Maintenance and Repair of Roads." The morning session of Thursday, the 10th, was opened by D. H. Winslow, of Washington, D. C., who discussed "Instruction to Patrolmen." Then followed the "Economic Use of Prisoners in Repair and Maintenance of Roads," by H. Hocutt, Highway Superintendent of Hickory Nut Gap Road; and the "Use of State Prisoners in Road Construction," by H. B. Varner, of Lexington, Chairman of the State Prison Board. J. N. Ambler, of Winston-Salem, spoke next on the "Essential Qualifications for a Highway Engineer," and at 11:45 a.m. Prof. Collier Cobb discussed "Geology as an Asset to a Highway Engineer." The afternoon was given over to practical demonstrations in the maintenance and use of various road implements.

The discussion Wednesday hinged on the question of "Road Construction," W. S. Fallis, of Raleigh, State Highway Engineer, and R. P. Coble, of Raleigh, were among the Wednesday speakers. Wednesday evening D. H. Winslow gave a very interesting illustrated lecture on "Maintenance of Roads."

Prof. A. D. Williams, of the University of West Virginia, and State Highway Engineer of West Virginia, gave an excellent talk at the morning session on the "Location of Roads," bringing to the attention of those present a great many points of vital interest and importance in connection with road location, the most important item of road construction.

Mr. W. S. Fallis, State Highway Engineer, opened a discussion on "Steam Shovels," which was followed by a statement from Mr. J. B. Clingman, Highway Engineer for Madison County, giving data as to work accomplished in his county by use of the steam shovel. The discussion of this question by other engineers present brought out some interesting points which will undoubtedly cause a more general appreciation of the benefits which can be obtained by the use of this machine in certain sections and under certain conditions.

Professor Williams then took up the discussion of the "Relationship of Superintendents and Engineers to Highway Commissions," and showed conclusively that each has a distinct and important place in the road work, that they were interdependent.

Mr. Winslow, of the United States Office of Public Roads, and Mr. Nello Teer, a grading contractor, along with representatives of various machinery companies, then discussed certain types of road machinery. The use of these machines was then demonstrated in the afternoon by Messrs. Mulligan, Winslow, and Teer. The demonstration of the construction and use of the road drag and road hone was received with great interest by those attending the Institute and this practi-

cal feature was emphasized each afternoon. A section of the main street of Chapel Hill was worked with the road machine and brought into first-class condition, with right crown and slope to ditches.

Mr. Winslow, of the Office of Public Roads, gave an illustrated lecture on the "Maintenance of Roads." The pictures were of portions of the National Highway, which is now under his immediate supervision. He has charge of the maintenance of this highway from Petersburg, Virginia, to Fayetteville, North Carolina, and is carrying it out through the patrol system. This system is comparatively new to North Carolina, and the success which it has attained on this highway is of great interest to commissioners and engineers who are seeking an efficient system of maintenance for their counties and townships.

Mr. Mills, of the American Association of Cement Manufacturers, gave an illustrated lecture on proper methods of mixing cement in the construction of cement roads. This type of road is almost new to North Carolina, and as it is now coming into vogue on roads near our towns and cities this lecture was of great value to engineers in the counties where this type of road will begin to be built.

On account of a number of engineers leaving, it was decided to close the institute after a morning, afternoon, and evening session, Friday, the 11th.

*Sampson County.* In Sampson County work is now being done on the road from Autryville to Roseboro with hired labor. The county is paying fifty per cent., and the parties along the route are paying fifty per cent. The convicts are now working between Roseboro and Clinton. They have just finished a piece of road in the Northern part of the county. There are now several squads of hired labor in the county.

While the good roads movement in this county has been somewhat slow heretofore, the people are now enthusiastic and are looking forward to having a splendid system of good roads in the near future.

*Alamance County.* In this county they have been building, during January, a little macadam road, doing some grading, and making fills to the new bridges. There has also been some repair work done on their dirt roads; and they have an outfit of seventeen mules and twenty-five men.

*Iredell County.* The road work in Iredell County is progressing very nicely. They have an outfit of twenty-six mules, and are doing quite a bit of cross-road, re-locating, and repair work; and are planning to do a good deal more work and better work this spring. They have contracted for the maintainance of about all the unsurfaced road work they have at an average cost of $11.45 per mile.

*Caldwell County.* Lovelady Township, Caldwell County, began work on May 10, 1915, having been at work about eight and one-half months. They have an outfit of twenty-nine mules, with a force of twenty to twenty-five men. Up to this writing they have completed grading and top-soiling fourteen miles of road.

The people along the road are making good progress cutting back the timber to keep it from shading the road.

*Cabarrus County.* It is reported that a movement is on foot to build a good highway on the county line on the Mount Pleasant-Concord road to meet the Rowan County good road, coming from the Stanly line, Salisbury. The road from Albemarle, east to Badin is built. The plan is to get the county commissioners of Montgomery County to co-operate with the Stanly Road Commission to build a bridge across the Yadkin at Badin and carrying the highway on to Troy. The idea is to connect the good roads of the west around Salisbury, Concord, and Charlotte with the eastern good roads system, bringing the road to Albemarle and Badin.

*Cleveland County.* No. 3 Township of Cleveland County has sold its $30,000 bond issue to the first National Bank of Shelby and work will begin in grading and surfacing of roads as soon as winter breaks. Lee W. Lynch, of Rutherford County, is surveying the roads, and S. S. Summey, who has had considerable experience in road building in Cleveland, Anson and Lincoln counties, has been engaged to supervise their construction. W. C. Sarratt, of Earl, is chairman. George B. Patterson, of Patterson Springs, and J. C. Bridges, of Shelby, Route No. 2, are other members of the Commission.

*Edgecombe County.* Edgecombe County has recently purchased a road motor truck. It is stated that tiling is being put in for drains across the roads of No. 5 township, and when the supply of tile now on hand is laid, there will not be a wooden bridge in the township.

No. 6 Township has begun work on the roads of the township authorized under the $30,000 bond issue voted some time ago. The State Highway Commission is co-operating with them in the work, and the surveys and plans will be made through the Commission. Mr. C. H. Bennett will be the superintendent in charge, and Mr. B. C. Pittman, of Whitakers, is chairman of the Township Board.

*Henderson County.* Dr. L. B. Morse, of Hendersonville, who is interested in an automobile highway from a point on the Asheville-Charlotte Highway to the base of Chimney Rock, upon returning from a recent trip to that section reported considerable interest in the new proposed highway from Bat Cave to Black Mountain.

As to the proposed highway, two miles of this road would lie in Henderson County, and following the beautiful rocky Broad River for about ten miles in McDowell County, to the summit of the Blue Ridge, crossing the range at Lakey's Gap, then entering Buncombe County and proceeding for about four miles to Black Mountain. This road would serve as a "cut off" between the State Highway through Black Mountain and the Asheville-Charlotte highway through Bat Cave and Chimney Rock. That portion of the road proposed in Henderson County has been graded. It is understood that $2,000 is available for that portion in Buncombe County. A mass meeting was recently held at Dome, in McDowell County, and it was decided to petition the county commissioners for a $5,000 road bond issue. For commercial and tourist purposes this road would be a great convenience and attraction, and the citizens in the territory to be traversed are highly enthused over the prospects for a good highway.

*Orange County.* A bridge is being built over the stream at Brockwell's pond near Sparrow's Mill. Considerable complaint is heard from all over the county of the non-maintenance of the roads built by the bond issue.

*Pitt County.* Chicod Township, Pitt County, voted a $50,000 bond issue in December. This is the fifth township in the county to vote bonds.

*Stokes County.* Contract has been let for a steel bridge across Town Creek at Kiser's Old Fort in the southern part of Meadows Township. The contract was awarded the Virginia Bridge and Iron Company for $1,474, work to be completed April 15, 1916.

*Person County.* Roxboro Township, Person County, began work September 1, 1915, on the "Brushy Fork" Road, with Mr. C. M. Colvin, foreman, twenty-five mules and the necessary machinery. There were four miles of this road to be improved. Up to December 24, 1915, there had been graded the four miles, culverts had been put in, and soil had been put on three and one-fourth miles at a cost of $6,800. This was comparatively a very costly road to grade. On January 4 they began grading on the Allenville Road. This road is three and one-half miles long. The entire length was graded in fourteen working days at a cost per yard of thirteen cents. This road is now being soiled. There have been five other roads located, and the grading of three roads has been let to contract. The soiling will be done with the regular force. This township will have the benefit of co-operation between the Township Highway Commission and W. S. Fallis, the State Highway Engineer, in all this work.

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## Regulations and Restrictions which Influence the Planning of Streets and Street Systems

Nelson P. Lewis, Chief Engineer, Board of Estimate and Apportionment of New York City

IN developing a plan for a system of streets or highways, the engineer must of necessity take into account certain reasonable regulations or restrictions which, if not already in force, are likely to be enacted and imposed upon those using the highways and those who own the abutting property. The function of the city street is twofold—to furnish light, air, and access to the abutting property and to provide for traffic,

Abstract of lecture delivered before the Graduate Students in Highway Engineering in Columbia University at the Automobile Club of America on January 6, 1916.

the origin and destination of which is elsewhere than along the portion of the particular street under consideration, the route to be followed by such traffic being controlled by directness or ease of movement in the case of business and by pleasant surroundings in the cases of pleasure traffic. Considerations will first be given to the control and restriction of street traffic.

When we recall the conditions which prevailed before a serious attempt was made to control or restrict the movement of vehicles in the public streets, when every driver of a vehicle was permitted to move in any direction he saw fit, to cross other streams of traffic when he would or could, to stop in any portion of the highway he pleased, the result being an inextricable tangle of vehicles with frantic horses and cursing drivers, the beneficial effects of rigid control of traffic movement will be appreciated. It has been said that the purpose of traffic regulation is to enable an amount of traffic to pass through streets which are inadequate in the absence of such control and to thereby avoid the enormous expense of widening existing roads or providing new roads in order that each vehicle might continue to move independently of other vehicles. When regulations for traffic control were first enforced they were strongly resented but the drivers of vehicles soon saw that such control was not only reasonable and necessary, but that it enabled them to reach their destination more quickly and comfortably, and they now readily acquiesce in any new rules which have for their purpose still further avoidance of congestion. Traffic regulation in New York and in other American cities is now as intelligent and effective as in any of the great cities of the world. A study of traffic problems is essential for the proper design of public highways and the determination of the relative width to be devoted to roadways and sidewalks. In American cities the surface railroad is the most efficient means of transportation through the public streets, but it has the disadvantage of inflexibility and inability to get around a temporary obstruction. In this respect the free wheel vehicles, such as the motor omnibuses so generally used in London and some other European cities, have a distinct advantage although their carrying capacity is less and their cost of operation for each passenger is considerably more, yet they avoid the large initial expenditure for permanent way, for power houses and electrical conductors. With the method of traffic control on busy streets such as Fifth Avenue everyone is familiar. The block system or the alternate stopping and releasing of traffic on two intersecting streets appears to be the simplest solution, but where each of these street intersections is treated separately, the traffic which is released at one crossing is likely to reach the first cross street just in time to be caught there so that it is obvious that the unit of control must be more than in a single street. The experiment has lately been tried of treating not less than ten cross streets or half a mile on the principal avenue as a unit, stopping and releasing the traffic at all of the cross streets within this distance simultaneously, and this promises much more satisfactory results. In some places the streets are scarcely able to accommodate pedestrian traffic at certain hours of the day. At the Liverpool Street Station of the Great Eastern Railway in London 100,000 people arrive at and a similar number depart from that station daily, and it will be apparent to one who will look at a map of this part of London and note the narrow, tortuous streets leading from this station that the congestion is acute.

The tendency to increase the width of vehicles, such as motor trucks, will be attended with serious complications. If a roadway is designed to accommodate four lines of moving traffic, two in each direction, and if owing to an increase in the width occupied by a line of vehicles, only three lines can be accommodated, it is apparent that the capacity of the street has been reduced by more than half, as the third or central strip will have to accommodate vehicles moving in both directions and the interference will be such that it will be of little value.

Restrictions upon the use of abutting property, especially the height to which buildings may be carried, has not gained much headway in the United States, although the reasonableness of such regulation is freely admitted in European cities. The existence or absence of such restrictions will have a great effect upon the design of the street system. Not only does over-intensive building produce an amount of traffic greater than a street can accommodate, but to insure good sanitary conditions or ample light and air the height of the abutting buildings should be in proportion to the street width. In many of the European cities this height can never exceed the width of the street itself, while in outlying or suburban sections, it is frequently much less. The only city in the United States approaching the restrictions so commonly found in Europe is Washington, where the extreme limit of height allowed is 160 feet on its very wide Pennsylvania Avenue, 20 feet more than the street width on other business streets, with a limit of 130 feet, 60 feet on streets from 60 to 70 feet wide, and the street width where that width is less than 60 feet. New York City has no limit except for tenement houses, the height of which cannot exceed one and one-half times the street width. Chicago has the same limit for tenements and a limit of 200 feet for office buildings. Charleston, New Orleans, Cleveland, and Fort Wayne restrict the height to two and one-half times the width of the widest street, with absolute limits of 125 feet in Charleston to 60 feet in New Orleans and 200 feet in Cleveland and Fort Wayne. Boston has a limit of two and one-half times the street width, but in no case to exceed 125 feet. This relates, however, to the business portion of the city, while in other sections the limit is 80 feet, while wooden buildings are limited to three stories and in no case more than 45 feet in height.

Limitations as to the proportion of the lot which may be occupied are very general in Europe and are becoming more and more frequent in the United States. These limitations, however, are based upon sanitary grounds rather than on the avoidance of street congestion.

* * *

## Street Cleaning in Milwaukee

(*Continued from March issue.*)

When intersecting streets are encountered, the two rear machines perform the work and then return to the original formation. A great deal more territory is thus covered than if the machines were paired and each allotted a given area.

The day work is performed in a like manner except that the remaining four machines are assigned to outlying districts and are confined thereto.

COST OF FLUSHER OPERATION.

| | | |
|---|---|---|
| Fixed charges | | |
| Depreciation at 10% on $1,000 (wagon and tank) | $100.00 | |
| Depreciation at 25% on $500 (engine) | 125.00 | |
| Interest at 4½% on $1,500 (total cost) | 67.50 | $292.50 |
| Maintenance | | |
| Painting (each season) | 20.00 | |
| Hose and couplings (each season) | 15.00 | 35.00 |
| Total season cost | | $327.50 |
| Cost per day (150-day season) | | $2.18 |
| Operating | | |
| Team and driver at $5.00 per day | 5.00 | |
| One laborer at $2.00 per day | 2.00 | |
| Water | .90 | |
| Gasoline | .55 | |
| Oil | .10 | 8.55 |
| Total cost per day | | $10.73 |

UNIT COSTS.

| SECTION | Number of Machines Used | Yardage Cleaned | Number of Times Cleaned per Week | Cost per 1000 Square Yards (Cents) | Assessment per Front Foot, 30-feet Street Cleaned 50 Times per Season (cents) |
|---|---|---|---|---|---|
| 1914 | | | | | |
| Central "A" | 4 | 118,709 | 1 | 36.1 | 2.98 |
| East | 4 | 115,137 | 1 | 37.2 | 3.08 |
| North | 4 | 115,998 | 1 | 37.0 | 3.06 |
| South | 4 | 111,420 | 1 | 38.5 | 3.18 |
| West | 4 | 116,870 | 1 | 36.7 | 3.04 |
| Central "B" | 4 | 115,560 | 1 | 37.1 | 3.06 |
| 1915 | | | | | |
| South | 2 | 242,000 | 2 | 26.2 | 2.20 |
| East | 4 | 297,200 | 1 | 29.7 | 2.40 |
| West "A" | 4 | 301,000 | 1 | 28.5 | 2.20 |
| West "B" | 1 | 119,500 | 2 | 31.9 | 2.60 |
| North (6th Dist.) | 1 | 108,000 | 2 | 35.3 | 2.90 |
| North "B" | 4 | 285,000 | 1 | 30.1 | 2.40 |
| Business District Night Work | 4 | 292,800 | 3 | 29.9 | 2.40 |

The following tables show the present yards cleaned and also the number of times they are cleaned in contrast to what should be done:

PRESENT.

292,800 square yards cleaned 3 times per week
469,500 square yards cleaned 2 times per week
883,200 square yards cleaned once per week

1,645,500 total yardage cleaned

PROPOSED.

592,498 square yards should be cleaned 2 times a week
757,832 square yards should be cleaned 3 times a week
670,532 square yards should be cleaned 6 times a week

2,020,862 total number of yards that should be cleaned

At present the city operates four machines daily or eight hours, and four machines day and night or 16 hours.

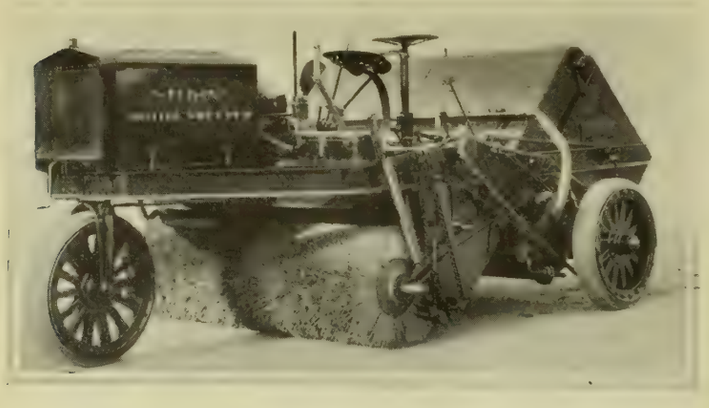
As a flusher can clean on the average 40,000 square yards per day, it would require a total number of 31 machines to clean the streets in the above mentioned manner.

This means an addition of 23 machines to the present amount.

By operating 23 additional machines it would eliminate the service of—

| | |
|---|---|
| 23 white wings at $2.00 per day x 150 days | $ 6,900.00 |
| 23 sprinklers at $6.34 per day x 150 days | 21,873.00 |
| Total | $28,773.00 |
| *Once a week flushing | 6,169.75 |
| Grand total | $34,942.75 |
| Cost of operating 23 machines 150 days | $37,018.50 |
| Less | 34,942.75 |
| Excess cost in operation | $ 2,075.75 |

*This item is included because certain streets are only cleaned once a week that require the service six times weekly; and if performed the maximum number of times would eliminate the stipulated number of white wings and sprinklers.



The Bureau makes the following comments on flusher cleaning:

"In recommending the flusher process of cleaning the Bureau wishes to say that sprinkling of streets will be greatly reduced and the slippery surface of the thoroughfares due to this valueless method will not longer exist; and that a cleaner and more sanitary condition will be the result.

"To flush the streets and remove the cause of insanitation at an increased cost is of greater benefit to humanity than to allay it indefinitely because of a slightly reduced expenditure."

SPRINKLER OPERATION.

The Bureau of Street Sanitation possessed 123 Studebaker sprinklers during 1914. They were operated under the jurisdiction of ward superintendents who laid out the routes "as best they knew" but, according to the Research Bureau, they invariably were inadequate.

"This service," says the Bureau of Municipal Research, "at its best is of no benefit as it does not clean, but only allays the dust on the street while in its wet condition, and requires the further process of cleaning by the flusher or squeegee and the white wing.

"If the Bureau of Street Sanitation possessed a sufficient amount of modern equipment to clean the streets more frequently, the valueless method of sprinkling could be eliminated, and an enormous expense abolished. However, under the present condition the process is a necessity, and will remain so until the facts are realized and the wishes of the Bureau are granted.

"The present method is operated under the direction of the District Supervisors. The number of times a street is sprinkled daily depends wholly upon weather conditions, the nature of the pavement, and the location; and rarely exceeds four trips. Where night flushing is performed sprinkling is eliminated entirely and on daily routes when squeegeeing or flushing is being done the sprinklers are withdrawn indefinitely."

For the preceding year the Bureau of Street Sanitation's report shows an expenditure of $60,310.05 for this service, of which $55,104.77 was kassessed to the property owners—leaving a balance of $5,205.28 chargeable to the General City Fund. This sum, together with the cost of water and hydrant rental amounting to $25,329,88 (which is non-assessable), makes a total expenditure for the city in the sum of $30,535.16.

The following tabulation shows the cost of operation of sprinklers:

COST OF SPRINKLER OPERATION.

| | | |
|---|---|---|
| Fixed charges | | |
| Depreciation at 5% on $325 | $16.25 | |
| Interest at 4½% on $325 | 14.62 | $30.87 |
| Maintenance | | |
| Painting (each season) | 35.00 | |
| Hose and couplings (each season) | 15.00 | 50.00 |
| Total season cost | | $80.87 |
| Cost per day (150-day season) | | 54. |
| Operating | | |
| Team and driver at $5.00 | 5.00 | |
| Water at 6c per 1,000 gal | .80 | 5.80 |
| Total cost per day | | $6.34 |
| Average blocks sprinkled daily | | 80 |
| Average square yards sprinkled daily | | 96,000 |
| Cost per 1,000 square yards | | 6.6c |
| The assessment per front foot based on a street 30 feet wide and sprinkled twice each day for 150 days would be | | 1.6c |

ROTARY BROOM SERVICE.

In the industrial and outlying residential sections, and upon streets adjacent to wharves where pavements are constructed



of brick, sandstone, limestone, or granite, the rotary brooms are generally used.

The process of cleaning is done nightly and to prevent excessive dust a sprinkler is used in advance of the broom.

The Bureau of Street Sanitation operates eight Studebaker rotary brooms.

COST OF ROTARY BROOM SERVICE.

| | | |
|---|---|---|
| Fixed charges | | |
| Depreciation at 10% on (machine only) $250 | $25.00 | |
| Interest at 4½% on $250 | 11.25 | $36.25 |
| Maintenance | | |
| Minor repairs and replacements | 20.00 | |
| 6 brooms at 50 lbs. bamboo each at 8c per lb | 24.00 | |
| 48 hrs. labor at 25c per hour | 12.00 | $56.00 |
| Total season cost | | $92.25 |
| Cost per day (150-day season) | | $0.615 |
| Operating | | |
| 2 sweepers at $2.00 per day, each | 4.000 | |
| Team and driver at $5.00 per day | 5.000 | |
| Grease, etc | .050 | 9.050 |
| Total cost per day | | 9.665 |
| Average yardage cleaned, 40,000. | | |
| Average cost per 1,000 square yards, 24.1c | | |

COMBINED WITH SPRINKLER.

| | | |
|---|---|---|
| Sprinkler team per day | $5.00 | |
| Water | .90 | $5.90 |
| 40,000 square yards sprinkled, cost per 1,000 yards | | 14.7c |
| Broom cost per 1,000 yards | | 24.1c |
| Combined cost per 1,000 yards | | 38.8c |

The assessment per front foot based on a street 30 ft. wide and cleaned 50 times a season would be 3.2c, if assessed.

PICK-UP SWEEPER SERVICE.

Though there are none of these machines in use in Milwaukee, the Bureau of Municipal Research recommends them as follows:

"A perfect device of this nature will eliminate the insufficient insanitary and expensive methods of sprinkling and dry sweeping.

"All that is required as assistance thereto is a vehicle to remove the collection after the filled receptacle of the sweeper has been dumped for removal.

"This machine will travel at the rate of four miles per hour, which exceeds by a great margin the speed attained by any team.

"In the interest of humanity it is necessary to speedily remove the accumulation of refuse from a congested thoroughfare, which is impossible by any other method.

"In this city are many streets that need constant attention that receive but little owing to lack of equipment, and if machines of this kind were purchased more frequent cleaning would be the result.

"It is the only method that could be employed in the cleaning of macadam pavement without any serious results, as the present system of constant sprinkling to allay the dust is detrimental as it causes rapid deterioration."

COST OF OPERATING PICK-UP SWEEPERS.

| | | |
|---|---|---|
| Fixed charges | | |
| Depreciation at 50% on $4,000 | $2,000.00 | |
| Interest at 4½% on $4,000 | 180.00 | $2,180.00 |
| Maintenance | | |
| Minor repairs (estimated) | 25.00 | |
| Replacement of brooms, 30 at $6.00 each | 180.00 | |
| Labor, making brooms | 60.00 | 265.00 |
| Total season cost | | $2,445.00 |
| Cost per day (150-day season) | | 16.30 |
| Operation | | |
| 1 chauffeur at $3.00 per day | 3.00 | |
| 2 sweepers at $2.00 per day | 4.00 | |
| 1 team, one-half time at $5.00 per day | 2.50 | |
| Gasoline and oil | 1.25 | |
| Water | .12 | 10.87 |
| Total daily cost | | $27.17 |

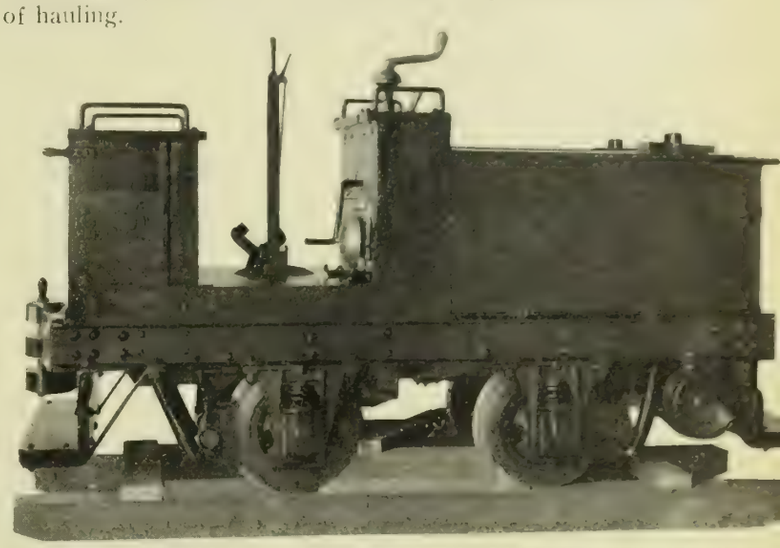
From personal observation the Bureau calculated that this machine (Elgin Sweeper, manufactured by the Elgin Street Sweeper Company, Elgin, Illinois) could operate at a speed of four miles per hour and perform the work at about 75 per cent. efficiency. At this rate 126,720 square yards would be cleaned in one day at a cost of $27.17 or 21.4c per 1,000 square yards.

The assessment per front foot based on a street 30 feet wide and cleaned fifty times per season would be 1.77c.

HAULING ASHES AND RUBBISH.

The Bureau strongly recommends the use of motor trucks for hauling ashes and rubbish, for the following reasons:

"In order to obtain efficiency and economy in hauling ashes and rubbish it is essential to give consideration to all functions of the work; but the one of most vital importance is the cost of hauling.



"As ashes and rubbish weigh approximately 1,000 lbs. per cu. yard, a 3 yard wagon would contain only 1½ tons, which is far below the tonnage for a team, and its use should therefore be abolished. Assuming that a team with a wagon of this capacity is driven at the average rate of 3 miles per hour, they would be traveling but 9 yard miles per hour. The cost of hire being 62½c per hour, the yard mile would then be 7c for 100% efficiency.

As loading consumes approximately 20% of the time
Hauling load to the dump.....40% of the time
And returning empty.....40% of the time

the efficiency is but 40% which increases the yard mile cost to 17.5c.

"A 5 cubic yard wagon operating efficiently would travel 15 yard miles per hour; and as the cost of team hire is standard the yard mile cost would be reduced to 4.16c at 100% efficiency. The loading time in comparison with the wagon of a lesser capacity would increase to approximately

30% of the time
And the hauling time to.....35% of the time
And the return time to.....35% of the time

reducing the efficiency to 35%, but would also reduce the yard mile cost to 11.8c; a reduction over the 3 yard type of 5.7c per yard mile.

"More modern methods present the use of auto trucks, and from actual test made by this Bureau, 8 cubic yards were hauled at the rate of 10 miles per hour, which represents 80 yard miles per hour."

The cost of operating the motor truck (built by the Sterling Motor Truck Company) was calcuated to be as follows:

| | |
|---|---|
| Fixed charges and maintenance | |
| Interest at 4½% on $4,000 | $180.00 |
| Depreciation at 25% on $3,800 | 950.00 |

| | | |
|---|---|---|
| Depreciation of 100% on tires $200 | | $200.00 |
| Garage, yearly rental | | 120.00 |
| Insurance | | 140.00 |
| Driver | | 900.00 |
| Total season cost | | $2,490.00 |
| Cost per day (300-day basis) | | $8.30 |
| Operation | | |
| Gasoline, 15 gal. at 11c | $1.65 | |
| Oil, grease and waste | .25 | 1.90 |
| Total cost per day | | $10.20 |
| Total cost per hour | | $1.275 |

Hauling 80 yard miles per hour, the yard mile cost was 1.59c at 100% efficiency.

With the proper forces, and operating in districts permitting the use of trucks

the loading was.....50% of the time
the hauling was.....25% of the time
and the return was.....25% of the time

therefore reducing the efficiency of the truck to 25%, and increasing the yard mile cost to 6.36c, a reduction of 11.14c over the 3 yard wagon.

The summary of the cost is as follows:

| | |
|---|---|
| Cost per yard mile, 3 yd. wagon | $0.1750 |
| Cost per yard mile, 5 yd. wagon | 0.1180 |
| Cost per yard mile, auto truck | 0.0636 |

The auto truck operated at 10 miles per hour for 8 hours at 25% efficiency, and hauling 8 yard loads would travel 160 yard miles per day at the cost of $10.20.

To accomplish the same yard mileage by 3 cu. yd. wagons the daily cost would be

160 x .175c = $28.00

And by the use of 5 yard wagons, the cost would be

160 x .118c = $18.88

This shows a daily saving for the auto truck in the sum of $17.80, and in order to pay for itself at the approximate cost of $4,000 less the depreciation of 25%, or the sum of $3,000, it would require only 168 days of full capacity work.

In conclusion the Bureau says:

"It is therefore more economical to operate an auto truck in such districts that permit of their use, than any type of wagon obtainable."

MODERN METHODS OF HANDLING ASHES AT THE INCINERATOR.

At present the ashes from the Milwaukee Garbage Incinerator are handled in small steel cars. These cars when loaded must be pushed up an incline and out to the dump along the lake shore, a distance of about 300 feet.

Because of the antiquated method of removing ashes at the incinerator, four men are required for this work per shift of eight hours, or twelve men per day.

The Bureau has conducted experiments with a gasoline locomotive, built by the Milwaukee Locomotive Manufacturing Company, Milwaukee, Wisconsin, for hauling the ash cars from the basement out to the dump, which made it clear that such a method would be entirely practical. By the use of this locomotive costing $1,650, the force of ashmen could be reduced one-half, thereby effecting a saving of $4,300 per annum.

## SUMMARY OF COSTS.

STREET SANITATION.

| Equipment | Average Cost 1,000 Sq. Yds. | Cost per front foot. |
|---|---|---|
| Horse-drawn Squeegee | 25.5 cents | 2.0 cents |
| Motor-driven Squeegee | 16.5 cents | 1.4 cents |
| Horse-drawn Flusher | 37.1 cents | 3.0 cents |
| Horse-drawn Sprinkler (2 trips) | 13.2 cents | 1.6 cents |
| Horse-drawn Rotary Broom | 38.8 cents | 3.2 cents |
| Motor-drawn Pick-up Sweeper | 21.4 cents | 1.7 cents |

HAULING ASHES.

| Equipment. | Cost per Yard Mile. |
|---|---|
| 3 yard Dump Wagon | 17.5 cents |
| 5 yard Dump Wagon | 11.8 cents |
| 8 yard Dump Auto Truck | 6.3 cents |

The conclusions, drawn by the Bureau, are summed up in the following words:

"In conclusion the Bureau of Municipal Research presents this summary of costs to show that the proper type of equipment is cheaper to operate than the old type of equipment. . . . "Few people understand that the difference of a few cents in the unit cost of doing work amounts to thousands of dollars during the course of one year because of the great volume of work done by the department of Public Works.

"At this time, October 1, 1915, the savings in the Bureau of Street Sanitation and Collection of Garbage and Ashes, due to the systematizing of the work, have amounted to the following sums, as compared with the same time for the year 1914:

| | 1914. | 1915. | Decrease. | Increase. |
|---|---|---|---|---|
| Supervision | $ 37,001.97 | $ 30,465.00 | $ 6,536.97 | ..... |
| Ash Collection | 174,757.23 | 153,650.56 | 21,106.67 | ..... |
| Street Cleaning | 184,250.70 | 130,583.61 | 53,667.09 | ..... |
| Sprinkling | 50,630.94 | 35,496.88 | 15,134.06 | ..... |
| Flushing & Squeegeeing | 11,413.85 | 17,702.49 | ..... | $6,288.64 |
| Total | $458,054.69 | $367,898.54 | | |

TOTAL SAVINGS .....$90,156.15."

* * *

## Oklahoma

### Work Accomplished by the State Highway Department to December 31, 1915, and Prospective Work to be Done

ORGANIZATION OF THE DEPARTMENT OF HIGHWAYS.

The Department of Highways of Oklahoma as it now exists, was created by the 1915 session of the State Legislature and the initial organization of this department was made at the time the law took effect on June 22, 1915. The new law provided that the Governor, by and with the consent of the State Senate, should appoint a Commissioner of Highways; and said Commissioner of Highways, with the consent of the Governor, was authorized to appoint a State Engineer and Assistant State Engineer and one stenographer. On June 22, 1915, Col. A. N. Leecraft, Secretary to the governor, was appointed temporarily as Commissioner of Highways. Mr. Leecraft then, with the consent of the Governor, appointed W. P. Danford as Assistant State Engineer and immediately opened up the office of the Department of Highways. On August 1, 1915, a more permanent organization was made by the appointing of George B. Noble, Commissioner of Highways; W. P. Danford as Acting State Engineer; C. G. Adkins, as Assistant Engineer, Professor J. I. Tucker, Instructor of Engineering at the State University at Norman, Oklahoma, was also designated to act in an advisory capacity to the Department of Highways, and assist in publicity work and the preparation of standard forms, specifications, etc. Such an organization was necessary for the reason that it quickly developed that the number of employees provided by law for this Department were entirely insufficient to perfom the duties imposed by law on the Department of Highways. Mr. Adkins, who filled the position of Assistant Engineer, being in fact an expert accountant, devoted his time largely to bookkeeping in connection with the registration of motor vehicles.

DUTIES OF THE DEPARTMENT OF HIGHWAYS.

The duties imposed by law upon the Department of Highways were, briefly, to have supervision of all matters relating to State roads and other highways; to prepare standard plans and specifications for the construction of roads and bridges; to inspect and pass upon the detailed plans and specifications for roads and bridges, prepared by the various County Engineers throughout the State; to compile statistics relative to the mileage, character, conditions and cost of construction, and maintenance of highways and bridges throughout the State; to investigate and determine the methods of road construction best adapted to the various sections of the State, and to register and place a tag on each motor vehicle operated or driven upon the public highways of the State. This included all classes of automobiles, motorcycles, and traction engines. It further devolved upon the Department of Highways to collect the money for such registration, place such money in the State Depository and disburse this fund to the various coun-

ties from whence it came, with the exception of 10 per cent., which is paid into the State Treasury and placed to the credit of the general revenue fund of the State, and it is provided by law that the money derived from the registration of motor vehicles shall be used for the maintenance of State roads only.

COUNTY AND TOWNSHIP ORGANIZATION—DESIGNATION OF ROADS AND FINANCES.

It is required, briefly, that the Board of County Commissioners of each county shall appoint a County Engineer, such engineer having first passed an examination and secured a certificate of competency from the Department of Highways. After the appointment of the engineer, it is the duty of the County Commissioners, with the assistance of the Engineer, to select not less than 10 per cent. nor more than 15 per cent. of the main traveled roads of the county as the State road system, the location of such roads to be marked on a map and subjected to the approval of the Department of Highways. After such approval by the Department of Highways of the State Road System in a county, it is the duty of the County Engineer, under the supervision of the Department of Highways to survey and prepare plans, profiles and specifications for the work necessary to be done on the State Road System. When such plans, profiles, and specifications have been approved by the Department, the Board of County Commissioners, with the assistance of the County Engineer, may then proceed to construct the State roads. In addition to the State Road System, it is provided that each township shall have a Township Road System, and that after all the State roads have been improved in accordance with the plans of same, additional mileage may be added from the Township Road System. In the construction of State roads, it was also provided that State convicts might be used, the county desiring to use the convicts to bear the cost of transporting the men, animals, tools, guards, and equipment from the prison or other location where they were confined, to the place where the work was to be done, and to furnish feed for the animals, board for the guards, fuel, supplies, and road material. This provision has, however, been so far ineffective for the reason that the Legislature failed to furnish funds necessary to provide equipment for the use of the prisoners, and the cost of the work done on the State Road System has been met by a quarter mill tax levy and by private subscription, the amount of the tax levy being insufficient to construct a great amount of highways. The cost for the construction and maintenance of the Township roads is covered by a tax levy limited to one and one-half mills for construction and two mills for maintenance. In addition, the Township may vote Township bonds for the construction of Township roads. The cost of building bridges throughout the county is covered by a tax levy or bond issues.

WORK DONE.

The Department of Highways has registered and collected tax or license fee from 25,019 automobiles and motor trucks, 1,755 motorcycles, and 592 tractors, and from 668 dealers in motor vehicles. The amount of taxes collected by this Department during 1915 is $154,198.58. Eighty-eight applicants have been examined for position of County Engineer, of which number thirty-six were given permanent certificates of competency, and twenty-three were given temporary certificates requiring further examination at the end of six months, so that there were fifty-nine engineers available to serve the seventy-seven counties of Oklahoma either in a permanent or temporary capacity. The law provides that one engineer may serve for more than one county and seventy-two of the seventy-seven counties have appointed county engineers. Over two hundred and fifty plans for bridges to be erected at an approximate total cost of $425,000, and fifty plans for culverts at an approximate total cost of $20,000 have been examined and approved. About fifty plans for bridges and culverts have been disapproved as not complying with the loading requirement of the law, for bridges and culverts. Over two hundred miles of profiles and plans for State roads have been presented and approved. Under the head of Forms and Data Prepared, the Department has issued five circular letters containing general instructions to the various county officials, and seven forms which are now available for distribution, as follows:

Form of contract and bond for dragging State roads.

Form of contract and bond for dragging Township roads.

Form of resolution for County Commissioners preliminary to letting of bridge contracts.

Form of application to the Department for inspection of bridge plans.

Two forms of report blanks for road dragging contractors.

Sample form of County road map showing the State Road System divided into sections.

Other forms and plans are now in the course of preparation. Of the seventy-seven counties of the State, seventy-one have designated their State Road Systems, with a total of 12,604 miles. These State roads will be presently adjusted by the County Commissioners with the assistance of the Department of Highways, so that they will lead continuously from county to county throughout the State. Reports from forty-six counties show that 1,370 miles of State roads have been surveyed and plans and profiles made, and approximately two thousand miles of State roads have been constructed out of 12,604 miles that were designated. This does not include the mileage of the Township roads that are being constructed under Township Bond issue. Of State roads built, reports show that all but 21 miles are some form of earth roads. The 21 miles being constructed of concrete, macadam, or gravel. The amount of State roads actually built during the first six months' period of operation of the new road law, has been less than it will be during a like period in the future, for the reason that it has been necessary for the county commissioners to expend a considerable amount of money for the purpose of buying road building equipment, etc., in paying the County Engineers for preliminary surveys and the preparation of plans, specifications, etc. These expenditures will largely be an asset in future years. The cost of engineering has been, as a whole, reasonable. Reports showing that the average cost of preliminary surveys and plans for State roads in forty-six counties, where such work has been, is $10.05 per mile. In eight of the forty-six counties, such cost exceeded $20.00 per mile, and the remaining thirty-eight counties averaged $6.70 per mile. On account of the fact that the engineering feature is something in which the County Commissioners and the general public are not accustomed in Oklahoma, there has been some complaint about this expenditure, but it is thought on further consideration, when the County Commissioners realize that such preliminary engineering work need be done but once, as a rule, and is not construed as an annual expense in the future, they will be better satisfied that the public has derived a benefit commensurate with the amount expended for engineering. In many counties, the public has shown a commendable disposition to donate both time and money for the construction of roads and the commissioners have been able to accomplish results that would have been impossible to realize with the amount of tax levy permissible by law. It is expected that during the year 1916 from three thousand to five thousand miles of State roads will be built with a possibility of more than that amount, if arrangements can be made to use the State convicts. The Department of Highways has been entirely unable to give the various county commissioners, the assistance they are entitled, by reason of the fact that there seems to have been no adequate conception of the volume of detail and labor connected with the registration of motor vehicles, together with the inspection of plans and profiles for the State road system, and the collection of data necessary to be had before standard plans and forms may be intelligently prepared in such a manner that same can be used in all of the various counties of the State. The appropriation for the use of the Department of Highways for the fiscal year ending July 1, 1916, was $12,600 of which amount $7,000 was to cover the salaries of the Commissioner of Highways, the State Engineer, the Assistant State Engineer, and the stenographer, leaving $5,600 available for the purchase of registration tags, furniture and fixtures, printing, and contingent fund. Of the $5,600 available for these various incidentals, $3,000 was immediately needed for the purchase of tags and more than $2,600 was needed and used to cover postage on tags, correspondence in connection therewith, of which there was a considerable volume, to say nothing of the postage needed to cover the volume of correspondence reaching the office of the engineer for the Department of Highways. It developed that all of the time of the Commissioner of Highways was occupied in matters in connection with the registration of motor vehicles, together with consultations with various county officials

and others who visited the Department of Highways in connection with matters pertaining to the location or construction of State roads. The Assistant State Engineer had a tremendous task in the bookkeeping work in connection with such registration and the Acting State Engineer has had to confine himself to a hasty examination of plans and specifications presented for approval, having very little time left to be devoted to the preparation of any standards of forms necessary for the use of the County officials. As heretofore stated, the funds provided, exclusive of salaries, being needed entirely for the purchase of registration tags and postage, there were no funds available for the purchase of furniture, proper equipment or the employment of additional help and in addition it was necessary to purchase registration tags a second time during the fiscal year ending July 1, 1916, so that tags would be available for the use of the public on January 1, 1916. These emergencies were taken care of by the Governor allowing deficiencies in such amount as were absolutely necessary and by borrowing furniture and help from other departments of the State, when same could be spared without great inconvenience. During the first three months, under the organization of the Department of Highways, as many as seven additional employees have been borrowed and they, together with the regular force of the Department of Highways were frequently employed for from twelve to fifteen hours per day and in an endeavor to handle the business without delay. Notwithstanding these handicaps, the Department of Highways, during the first six months, collected from the registration of motor vehicles, the sum of $154,198.58, of which amount 10 per cent. or $15,419.85 was turned into the general fund of the State Treasury as required by law, no part of this fund being directly available by the Department. The expenses of the Department during the period mentioned, were $9,049.08, leaving a balance of $6,370.77, which could be counted as profit for the State in general, derived from the Department of Highways, exclusive of the profit to the general public from the assistance of the Department of Highways in getting State Road Systems designated in practically all of the counties and the supervision of plans for road and bridge work.

WORK CONTEMPLATED IN 1916.

During 1915 the Department of Highways was unable to register the electric motor vehicles by reason of a technical error in the law that failed to cover this class of vehicles. It is expected that the present extra session of the Legislature will provide a means for the collection of this tax on electrics to cover the year 1915 and 1916. Without outside assistance, it is expected that the Department of Highways will, during the year 1916, register at least 32,000 motor vehicles, exclusive of the electric and that given outside assistance in the collection of these taxes, they will be able to register from 35,000 to 40,000. For instance, the Department during 1915 registered 668 tractors. The records show that there are more than 1,000 tractors owned in the State and from reliable information based on the observation of officials in the Department of Highways, and from many other sources, it would appear that several thousand motor vehicles escaped registration last year. In many places this was possible by reason of the fact that the local officers from personal reasons, did not see fit to make arrests of persons who were violating the law in this respect, notwithstanding the fact that these officials have been repeatedly notified by the Department, such notice calling the attention to the officials of the loss to their county by reason of such neglect. The Department of Highways has received a great deal of encouragement from County Commissioners in many localities that have employed competent engineers to assist in the supervision of the construction of road and bridge work and such county commissioners have shown a willingness to co-operate with the Department of Highways in every way and to attempt to comply with the law so far as they are able to under its provisions. Excellent results have been shown in the past and are expected during the present year from those counties fortunate in having competent engineering services. There is a great deal of interest manifest in the proposed construction of hard surfaced permanent roads, to be built of macadam, brick, or concrete, and it is expected that if the present session of the Legislature encourages by law the means of obtaining funds for this purpose, many counties will vote bonds ranging from $50,000 to $500,000 for the construction of actually permanent hard surfaced roads.

* * *

## Central Michigan Roads

THE heart of Michigan, including the counties of Ionia, Clinton, Shiawassee, Eaton, Ingham, Livingston, Jackson, and Washtenaw, was the last portion of our State to be affected by the fever for better roads that has been sweeping it from north to south during the last few years. Not that we of central Michigan did not realize the need of a better class of roads; not that we were not as progressive, or even more so, than any other portion of our State along other lines, but from the fact that we have always had fair roads and until the time arrived that they would not uphold the severe auto traffic imposed upon them, we considered our roads good enough.



**Trunk Line Highway Bridge of Two-Span Concrete Girder Type, on Grand River Road, crossing the Red Cedar River**

Even before Michigan became a State, the Federal Government appropriated funds for the laying out and building of roads into this newly-settled territory. It was during the War of 1812, when supplies were sorely needed by the settlers, that three thousand dollars were appropriated by Congress to make



**Shiawassee River Bridge. Built by State Highway Department of Michigan.**

surveys on the Chicago-Detroit turnpike. A few years later, another sum of twenty-seven thousand dollars was apportioned to Michigan for the improvement of this road as well as many other roads that were rapidly being opened up in various portions of the territory. In those days Michigan was timber



**Approach to Red Cedar River Crossing from West. New Gravel Road in Foreground.**

and lumber poor. This naturally led the settlers to utilize it for every conceivable purpose. Consequently they used it as the wearing surface on their main roads for a great many



Trunk Line Highways in Jackson County, Michigan. Built of Gravel. In Central Picture Gravel is not Thoroughly Compacted.

years. Evidences of these old plank roads are still seen and "felt" as one drives over this section of the State. At first these roads were maintained by these settlers, and later, a great many were kept up by private corporations and individuals who charged all vehicles a certain toll for the use of the road. Later they went into the control of the townships through which they passed. From that time until now the township has been unable to keep up the maintenance on all of its roads, and in most cases every road in the township has suffered for lack of funds.

This very condition, and the advent of the automobile, did more than anything else to cause the legislature of 1905 to create the State Highway Department of Michigan. It also appropriated a sum of money to be paid as a reward upon all roads that were improved and passed inspection under the State Highway Department's specifications. As far back as 1893, however, a law was passed which allowed counties to build and maintain their highways separately from the townships within them. Nevertheless very little was accomplished among the counties of Central Michigan until some five or six years ago. At that time, the counties of Eaton and Jackson started work under the county system. Soon after, Ingham, Shiawassee, and Clinton counties adopted the system, and only last year a portion of Washtenaw formed what is known as the Eastern Washtenaw Good Roads District, which operates under a law similar to that of the county. The two chief advantages of the county system being, first, that it spreads the cost of constructing main roads over all the taxable property in the county, and second, that it tends to make continuous main roads with no breaks at the township lines. This desirable feature is never attained under the township plan, while town line roads invariably suffer.

The following table shows what each county in central Michigan has done to date, and what some of them expect to do the coming season:

| NAME OF COUNTY | No. miles of road built or applied for as State Reward Road | Amount to be spent for roads Season of 1916 | No. of miles to be built in Season of 1916 |
|---|---|---|---|
| Clinton | 32,684 | $ 24,429.17* | 17,750 |
| Eaton | 140,104 | 54,000.00 | 28,000 |
| Ingham | 92,104 | 90,671.68 | 25,000 |
| Ionia | 85,019 | ..... | ..... |
| Jackson | 100,512 | 127,090.43 | ..... |
| Livingston | 105,258 | ..... | ..... |
| Shiawassee | 131,941 | 14,150.00 | ..... |
| Washtenaw | 36,455 | 50,000.00 | 12,000 |
| Total | 724,906 | $360,341.28 | 82,750 |

*Bond issue to be voted on for $100,000.00 at next election.

This means that those counties, working under the county system along with the Eastern Washtenaw Good Roads District, will spend in the neighborhood of $360,000. This does not include what the townships in all of these counties will expend, which will undoubtedly be as much if not more than the amount the counties are spending as counties. It is also evident that by the fall of 1916 the counties of central Michigan will have considerably over eight hundred miles of road built and maintained under the specifications of the State Highway Department. This is indeed a wonderful showing when we consider that five years ago hardly a mile of road had been built that could be termed a permanent road.

It must be understood that ninety-five per cent. of all the land in these counties is of the best and is raising abundant crops for which there is a good market because of adequate railway facilities. Our cities and villages are alive and progressive, giving largely to the building of the main highways. But best of all is the fact that these counties are well supplied with an abundance of good road gravel, from which most of the roads are constructed. These natural features and modern advantages make it possible to build our roads without placing a burdensome tax upon us.

Here a word should be said about our Trunk Line Highways. The legislature of 1913 passed an act which created a system of highways connecting the chief cities and villages throughout the State, several of which cross the counties of central Michigan. On these roads a reward is paid by the State, which is double the amount given on roads not on this system. One road in particular—the old Grand River Road—connecting Detroit, Lansing, and Grand Rapids, passes through some of the counties in central Michigan. Nearly the entire mileage in these counties is either built or applied for. This road has been recently renamed the Wolverine Pavedway. On all these trunk line highways the State builds and maintains all bridges over thirty-foot span.

The completion of a system of good roads is the only thing that is holding the counties of central Michigan from being the best developed counties in our State, and as fast as funds can be raised, without placing a burden upon us, just that fast will our system of good roads be completed.

* * *

## Contract Procedure for Public Works

### By Hon. Morris L. Cooke, Director of Public Works of the City of Philadelphia

UNTIL our American cities eliminate undue profits, as well as graft from public contracts, good municipal government is out of the question. We will have inefficiently managed cities as long as graft is allowed to demoralize men and women in and out of public life, and so long as excessive profits on contracts give political bosses the funds wherewith they maintain standing political armies.

Lecture in the Graduate Course in Highway Engineering at Columbia University delivered on December 20, 1915, in the Assembly Hall of the Automobile Club of America New York City.

Our contract procedure suffers principally from three causes:

1. Lack of both definition and standardization in specifications.

2. An almost entire absence of research work in this field and (perhaps most important to all).

3. Too little regard for the dignity—one might almost say the sanctity—of contract procedure.

In expending upwards of $40,000,000 on contract work during the last four years, I have been convinced that we must surround the procedure not only with a maximum of publicity but with a great deal more of dignity, such as we find in the courts. Contractors as a class abhor favoritism as much as the taxpayers. The average contractor is willing to take his chances with his associates as long as he knows that everybody is getting the square deal and that nobody is getting special privileges. One contractor, however, receiving a preference makes all the rest struggle for a similar advantage.

World series, opera and prize fight tickets, dinners, cigars, candy and small loans must go. The whole contract world is honey-combed with a maze of small favors. Such big graft as there has been in Philadelphia has gone to a very few people. The rank and file of inspectors, clerks, bureau chiefs, directors, and others concerned, never have profited in any large way through graft. But there have been times when in some places a subordinate in this Department would not move a paper from one basket to another in order to expedite a payment without at least a smoke. Nobody would think of asking a judge to step out for a drink, or of sending him candy, cigars or flowers at Christmas. Those in any way connected with contract work should assume the same dignified attitude and absolutely refuse to have any relations whatsoever with contractor, except those contemplated by the specifications themselves. Experience has shown that in order to keep straight in this field some special and perhaps unusual precautions must be taken. It is up to everybody in high and low places to take a hand in keeping every situation sweet as new mown hay. If everybody knew how to draw the line this would not be necessary, but unfortunately very few inspectors and others engaged in this kind of work are able to discriminate. So the safest way—and the only way—is to act in every situation as one would if holding a position on the bench.

The procedure now followed in advertising contract work and in receiving and opening bids in the Lieutenants' Room in the Safety Department marks a radical step forward. Formerly the advertising was done too frequently in local papers. The specifications, especially on big jobs, were frequently not ready until a few hours before the bids were to be opened. The bids for highway work were received in the bureau in a very informal way, and when opened were read in a mumbled voice which made it impossible for any one in the room to hear. All this made the juggling of awards very easy. Now the work is never advertised until the specifications are ready, the advertisements are printed in bold faced type, and published in the principal papers of the city. The specifications are issued freely to any one requesting them. No record is kept of the names of those asking for them. They are deposited in a box behind an iron grating in one of the main corridors of the City Hall. The procedure of opening is under the direct supervision of the Assistant Director of the Department. The unit prices and other conditions of the several bids are read out in a loud tone of voice and posted on a blackboard where everybody can see them.

For three years the officials of the Department of Public Works have been engaged on standardizing the general clauses of the specifications which are used in all contract work. At the beginning of this Administration the general clauses used varied even for different kinds of work in the same bureau. The practice in each bureau was first standardized and now after months of work by a committee consisting of William H. Connell, Carleton E. Davis, and George S. Webster, the general clauses of the three bureaus doing the largest amount of contract work, have been reconciled and brought to one general standard which has been adopted for all contract work of the Department of Public Works. Obviously, this type of standardization goes a long way toward preventing the injection of jokers or clauses which may be variously interpreted, according to who the contractor happens to be.

The great safeguard in contract procedure is publicity at every stage of the procedure. This must be begun when the specifications are drawn so that everybody knows as nearly as possible what is meant by them. It should include having every construction job marked to let the citizens know what is being built and what it is for; and, of course, it must provide for the fullest possible and most accurate records whereby the history of any particular contract can be traced in its every detail.

One important change wrought in the last four years has been that every payment to a contractor, except those made directly under the terms of the specifications has been recommended by a Bureau Chief in writing and approved by the Director, and placed on file with the Controller and in two offices in the Department. No extras are allowed, except on such a statement. In case investigations are at any time made as to payments under any given contract, these papers, together with the specifications themselves, should afford a complete explanation.

A number of changes in the procedure which are of direct interest and benefit to the contractors have been made. Heretofore checks deposited with bids have been held an indefinite time. Under our present practice, the unsuccessful bidders are notified the day the award is made that their checks are ready for return to them. In many cities the contractors are forced to put up large sized checks and those who are not in favor at the moment are penalized by having them held.

* * *

## The Relation of Size of Sand Grains to Strength of Mortar and Concrete*

Mr. Cloyd N. Chapman, Engineer of Tests, Westinghouse, Church, Kerr & Co., New York City

IN THE earlier days of the concrete industry, there was a general belief that the only factor affecting the strength of concrete made of any given proportions of cement, sand, and stone, was the cement itself. If a concrete failed, the cement always got the blame. If a job was well done and satisfactory, the cement manufacturer took all the credit, published photographs of the finished structure as an advertisement for his excellent brand of cement, and intimated that all that was needed to produce good concrete was to use the same brand of cement.

The belief became firmly fixed in the concrete man's mind that if a concrete were made on the formula 1:3:5, it was fair concrete, good enough for foundations, retaining walls, and the like. If it were made 1:2:4, it would be very good, suitable for reinforced floors, beams, girders, and columns. And if it were mixed 1:1½:3, it must be very excellent and good enough for the most exacting service.

Engineers, architects, contractors, and users of concrete generally, associated proportions inseparably with quality. So general was this belief that even great railroad systems established fixed proportions for concrete of various grades for different purposes without for a moment considering that at one end of their line the available sand was of very much poorer quality than at the other end.

In other words, the fact was not recognized that the quality of the aggregates should be taken into account in specifying proportions, and the same condition exists to-day in the minds of a great many men connected in various ways with the concrete industry. There are still numberless specifications for concrete written in which the proportions of cement, sand, and stone are arbitrarily fixed, without reference to the quality of materials to be used.

This is obviously a very wasteful method of procedure, as it necessitates the selection of such safe proportions in the arbitrary specification that even the poorest quality of aggregates that will pass inspection will produce concrete good enough for the purpose. This method gives no incentive to the selection and use of any better aggregate than that which will barely pass the requirements.

During the past few years, there has been a decided awakening to the influence of the aggregates used upon the quality of the concrete produced. Now, instead of condemning the cement whenever there is trouble, the aggregates are investigated and in the end usually have to take the blame. Probably

Presented before Section D of the American Association for the Advancement Science at the Columbus Meeting, December 29, 1915.

nine-tenths of the troubles reported from the field that the cement manufacturer is called upon to investigate are traceable to poor aggregate, and usually it is the sand.

There are a great many variables which affect the value of a sand as an aggregate for mortar and concrete, such as hardness, shape of grain, chemical composition, size of grain, presence of deleterious matter of various sorts, texture of surface, etc. Each of these qualities has an effect upon the mortar or concrete produced, but most of them are of such a nature that it is difficult or impossible to get any positive measure of the extent of the effect produced by them. It is

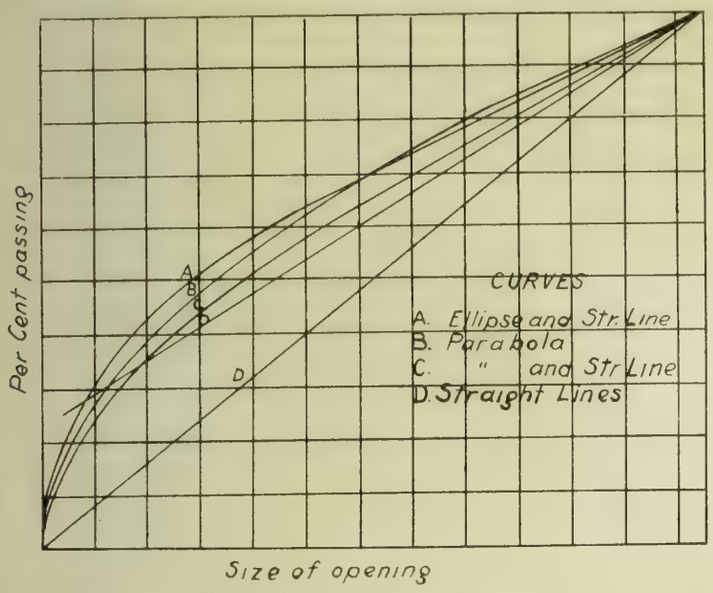



**Fig. 1. Curves of Maximum Density**

impossible in most cases to separate out one quality by itself in order to determine its effect and the relation it bears to quality of product. Take, for instance, the quality of hardness. To determine the relation of hardness of the sand particles to strength of the mortar and concrete it will make, it would be necessary to compare by test several sands differing from each other only as regards hardness of grains. All other qualities, including shape of grains, chemical composition, texture of surface, etc., would have to be identical in the several sands in order to reduce the variables to one, namely, hardness. It is impossible to get, or even to make, fine aggregates of varying hardness but of the same chemical composition. For a soft sand, one composed of soft limestone might be chosen, and for a hard sand, one of quartz or flint; but their radically different chemical composition, surface texture, etc., would have such an unknown influence on the concrete made from them that the effect due solely to hardness could not be segregated and measured.

In the matter of size of particles, however, it is not difficult to produce, by screening, sands of varying size whose other qualities are all identical. It is therefore easy to make at least approximate determinations of the effect that size of grains has on the quality of mortar or concrete.

It has been known and generally recognized that, with the same proportion of cement, and the other qualities of the sand being identical, a coarse sand makes better concrete than a fine sand, that a very fine sand makes very poor concrete, and that a very coarse sand is not as good as a sand graded from fine to coarse. It has been demonstrated repeatedly and conclusively that the best concrete can be made with an aggregate whose grains vary in size according to a fairly definite rule. This rule has found its most common expression in what is known as "Fuller's Curve," or sometimes called the "Curve of Maximum Density." Investigators disagree as to the best form for this curve, whether it should be a parabola, a combination of a parabola and a straight line, a combination of an elipse and a straight line, or simply a straight line. But whatever form is chosen, it will represent a sand whose particles vary in size fairly uniformly from the finest to the coarsest. In Fig. 1, these four forms of curves are illustrated for a sand whose coarsest particles will pass a four-mesh sieve.

It will be noted that two straight lines, *D* and *D*, are shown on Fig. 1, one of which passes through the origin and the other starts an arbitrary distance above the origin. These two curves have few advocates recommending them for fine aggregates, but for coarse aggregates the straight line passing through the origin has many upholders. They are shown here only as a matter of comparison with the more frequently used curves, *A*, *B*, and *C*. It will also be noted that there is not a very wide difference between curves *A*, *B*, and *C*, and it is undoubtedly true that a sand which conforms to any of them will, if its other qualities are good, produce a first-class, dense concrete or mortar.

It should be emphasized, however, that some sands whose granularmetric analysis curves do not conform to any of these curves, in fact, vary widely from them, will also produce high-grade concrete if their other qualities are of the proper values. On the other hand, their other qualities may be such as to greatly outweigh their lack of theoretically perfect size gradation. But as we are now discussing only the effect of size, we will overlook this fact and confine this argument to the one quality of size.

It is very generally accepted in the concrete industry that the dividing size between fine and coarse aggregates, between sand and stone, shall be that which will pass a four-mesh sieve. Accepting this arbitrary division as a proper one, let us compare the strength of mortars made with a sand which is well graded as to size of particles but whose largest pieces will just pass a four-mesh sieve, and other mortars made with similar sands, or the same sand, but whose largest pieces are less than that which will pass a four-mesh sieve.

Taking a well-graded sand, of high quality in other respects, whose largest particles will just pass a four-mesh sieve, and preparing a set of strength specimens made in the proportion of 1 : 3 and comparing them with other specimens made in the same proportion with the same sand but whose largest particles will pass an eight-mesh sieve, we find that the coarser sand gives a greater strength than the finer sand. Going further and using the same sand but screening out all particles that will not pass a twelve-mesh sieve, we find the strength of the specimens further reduced by a considerable proportion, and the further we go in the reduction of the size of the coarsest particles, the weaker become the test specimens.

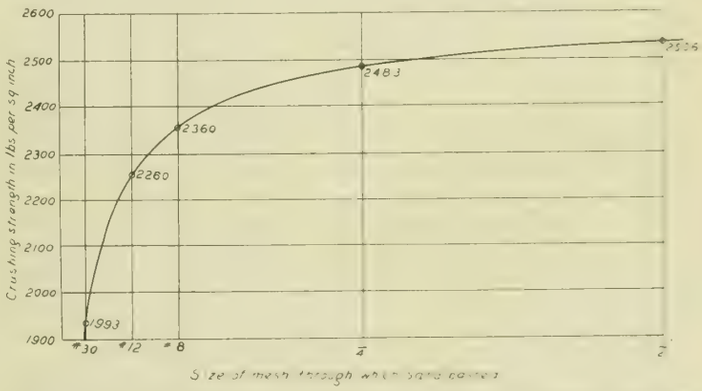



**Fig. 2. Curve showing relative compressive strength of Concretes made from well graded sands, ranging from dust up to the sizes indicated. Test pieces are cylinders 8 inches diameter by 16 inches high, average age two months. Proportions about 1:2:4, coarse aggregate ¼ to 1¼ consistency normal.**

Such a series of tests was very carefully conducted by the Committee on Concrete Aggregates of the American Concrete Institute, and the results are reported in the proceedings of the institute. They are very interesting, and as the experiments were carried out in a number of scientific laboratories in various parts of the country on various sands, the results may be accepted as trustworthy.

In general, these results show that the coarser sands make the stronger mortars, but that the ratio of strength of mortars made of coarse sand to the strength of mortars made of finer sands is greater than the ratio of the strength of concretes made with the coarser sands to the strength of concretes made with the finer sands. In other words, the effect due to size of sand grains is more pronounced in the case of mortar than in the case of concrete.

To show some of the details of the results obtained, a graphic representation will serve very well. In Fig. 2 are shown crushing strengths of concretes made from well-graded sands whose largest particles varied from thirty-mesh up to one-half inch. These results are the average of four series of tests made in college laboratories. Each series consisted of four specimens of each size, so that the results as shown by the curve are the average of sixteen specimens of each degree of coarseness.

# Report of the Special Committee on Materials for Road Construction and on Standards for their Test and Use

*(Continued from March.)*

CRUSHING STRENGTH OF ROCK OR SLAG.

Cylinders shall be cut from a suitable block of the material to be tested, each of which cylinders shall, as nearly as practicable, be five centimeters (two inches) in diameter and ten centimeters (four inches) in length. After cutting, the dimensions of each cylinder shall be accurately measured and recorded. Each cylinder shall then be subjected to compression, and the ultimate stress at which its failure occurs shall be noted. This stress divided by the average area in cross-section of the cylinder in square inches shall be reported. It is desirable that the test of the material shall be made on at least three such cylinders separately, and the average of the three or more specimens shall be taken as the average resistance to crushing of the material. In making the test, the cylinder shall be fixed in the testing machine so as to be unsupported on its sides and rest squarely on its ends, and the compressive stress shall be applied cumulatively. The ends of the cylinder shall be at right angles to its long axis, and the blocks or pieces of the machine in contact with the ends of the cylinder and through which the pressure is transmitted shall have such position and freedom of movement in the machine as will insure the application of the stress directly along or parallel to the long axis of the cylinder.

MECHANICAL ANALYSIS OF BROKEN STONE, BROKEN SLAG, OR GRAVEL.

The method shall consist of, first, drying at not more than 110 degrees, Centigrade (230 degrees, Fahrenheit) to a constant weight a sample weighing in pounds six times the diameter in inches of the largest holes required; second, passing the sample through such of the following sized screens having circular openings as are required or called for by the specification, screens to be used in the order named: 8.89 centimeters (3½ inches), 7.62 centimeters (3 inches), 6.35 centimeters (2 inches), 5.08 centimeters (2 inches), 3.81 centimeters (1½ inches), 3.18 centimeters (1¼ inches), 2.54 centimeters (1 inch), 1.90 centimeters (¾ inch), 1.27 centimeters (½ inch), and 0.64 centimeters (¼ inch); third, determining the percentage by weight retained on each screen; fourth, recording the mechanical analysis in the following manner:

Percentage passing 0.64 centimeter screen.....
Percentage passing 1.27 centimeter screen and retained on.. 0.64 centimeter screen.....
Percentage passing 1.90 centimeter screen and retained on 1.27 centimeter screen.....
Percentage passing 2.54 centimeter screen and retained on 1.90 centimeter screen.....

Total.....100.00

MECHANICAL ANALYSIS OF SAND OR OTHER FINE HIGHWAY MATERIAL.

The method shall consist of: First, drying at not more than 110 degrees, Centigrade (230 degrees, Fahrenheit) to a constant weight, a sample weighing one hundred grams; second, passing the sample through each of the following mesh sieves, the sieves to be used in the order named.

| Meshes per linear inch (2.54 cm.) | Diameter of Wire | |
|---|---|---|
| | Inches | Millimeters |
| 10 | 0.027 | 0.6858 |
| 20 | 0.0165 | 0.4191 |
| 30 | 0.01375 | 0.34925 |
| 40 | 0.01025 | 0.26035 |
| 50 | 0.009 | 0.22865 |
| 80 | 0.00575 | 0.1460 |
| 100 | 0.0045 | 0.1143 |
| 200 | 0.00235 | 0.05969 |

Third, determining the percentage by weight retained on each sieve, the sifting being continued on each sieve until less than one per cent. of the weight retained on each sieve shall pass through the sieve during the last minute of sifting; fourth, recording the mechanical analysis in the following manner:

Percentage passing 200-mesh sieve.....
Percentage passing 100-mesh sieve and retained on 200-mesh sieve .....
Percentage passing 80-mesh sieve and retained on 100-mesh sieve .....
Percentage passing 50-mesh sieve and retained on 80-mesh sieve .....

Total.....100.00

MECHANICAL ANALYSIS OF MIXTURES OF SAND OR OTHER FINE HIGHWAY MATERIAL WITH BROKEN STONE, BROKEN SLAG, OR GRAVEL.

The method shall consist of: First, drying at not more than 110 degrees, Centigrade, (230 degrees, Fahrenheit) to a constant weight, a sample weighing in pounds six times the diameter in inches of the largest holes required; second, separating the sample by the use of a ten-mesh sieve (American Society for Testing Materials standard sieve); third, examining the portion retained on the ten-mesh sieve in accordance with the method for making a "Mechanical Analysis of Broken Stone, Broken Slag, or Gravel"; fourth, examining the portion passing the ten-mesh sieve in accordance with the method for making a "Mechanical Analysis of Sand or Other Fine Highway Material"; fifth, recording the mechanical analysis in the following manner:

Percentage passing 200-mesh sieve.....
Percentage passing 100-mesh sieve and retained on 200-mesh sieve .....
Percentage passing 80-mesh sieve and retained on 100-mesh sieve .....
Percentage passing 10-mesh sieve and retained on 20-mesh sieve .....
Percentage passing 0.64 centimeter screen and retained on 10-mesh sieve.....
Percentage passing 1.27 centimeter screen and retained on 0.64 centimeter screen.....
Percentage passing 1.90 centimeter screen and retained on 1.27 centimeter screen.....

Total.....100.00

VOIDS IN MINERAL AGGREGATES.

The voids in mineral aggregates shall be determined by the Cone Specific Gravity Method. In the method of making the determination of voids, as hereinafter described, there shall be used a truncated cone made of No. 18 B. & S. gauge galvanized steel with caulked seams, and having the following dimensions: Over-all diameter of bottom, 25.4 centimeters (10 inches); over-all height, 25.4 centimeters (10 inches); inside diameter of opening, 7.6 centimeters (3 inches). The test shall be made in the following manner: First, thoroughly mix the aggregate by rolling on paper; second, fill the cone with aggregates, avoiding segregation; third, compact the aggregate in the cone by oscillation on edge of the cone resting on wooden floor, wooden box or block of wood, and use cotton waste pressed against the surface of the aggregate to prevent segregation during oscillation; fourth, continue to add the aggregate and compact until the cone is full of thoroughly compacted aggregate, which process will require from 300 to 500 oscillations; fifth, weigh the cone with the aggregate; sixth, weigh the cone empty; seventh, weigh the cone full of clean water; eighth, determine the specific gravity of the aggregate; ninth, the percentage of voids in the aggregate shall be calculated by the following formula:

$$\text{PERCENTAGE OF VOIDS} = 1 - \frac{C - A}{(B - A)D} \times 100$$

in which A=the weight in grams of the cone; B=the weight in grams of the cone filled with water; C=the weight in grams of the cone filled with compacted aggregate; D=the specific gravity of the aggregate.

This method of testing is that proposed in 1915 by Committee D-4, Standard Tests for Road Materials of the American Society for Testing Materials.

*(To be concluded in May.)*

## Snow Removal by Contract in New York City

By George D. Steele

*(Continued from March issue.)*

A truck is thus identified with the district in which it begins work and unless it is transferred, it may readily be determined to which district it belongs by those in charge.

The Superintendent of Snow Removal is in charge of all snow removal work, whether it is being done by contract or by the city forces, or by a combination of both methods. The Borough Superintendents are in charge under the Superintendent of Snow Removal of all snow removal work in the Boroughs of the Bronx and Brooklyn. These Borough Superintendents refer to the Superintendent of Snow Removal all matters arising upon the work upon which they have no instructions, and the decision of the latter is final in every case.

The District Superintendents are in charge of snow removal work in their respective districts, and they are personally held responsible for the conduct of snow removal work. Each District Superintendent is also held accountable for the instruction of his subordinates, and for the manner in which these subordinates perform their duties. The District Superintendent must be thoroughly familiar with all the rules and regulations of the Department so that he is in position to properly instruct his subordinates of the Department of Street Cleaning, employees and others assigned to snow removal work. When he goes out on snow removal work he reports at once by telephone to the Snow Office. The District Superintendent signs the blotter and arranges the equipment to be used in his district. He has charge of and delivers the punches to the District Snow Inspectors, assigns the loading foremen to their stations and delivers to each an indelible pencil and the gang allotment of truck tickets. He also assigns assistant loading foremen to their stations, dump formen to their stations and is required to inspect work at least twice a day, but more frequently if possible. He gives such field directions as may be necessary.

The District Superintendent is also required to observe the leading gangs and to insure himself that the loading foremen are performing their duties properly. He makes the same observation as regards the dump foreman. Should he discover any irregularities or improper methods being employed in carrying on the work, he is required to make a note of this, and to immediately change and correct the method. At all times he co-operates with the District Superintendent of Sewers in the use of the sewers for dumping snow, and will stop dumping into a sewer at a particular point or will change dumping points from one manhole to another or from one sewer to another upon request made by the District Superintendent of Sewers. When such a change is made, he must notify the Snow Office at once.

Should it be observed by or should it be reported to a District Superintendent that the capacity of any truck has been diminished, by the loss or removal of any part of the built-up portion, he at once notifies the Snow Office, but permits the truck so reported to continue working.

Should he direct the transfer of trucks from one gang to another, he gives the necessary orders to the loading foremen of the gangs affected by such changes. He also notifies the dump foremen of such changes so that they may collect the tickets of the trucks that are being transferred.

If trucks with serial numbers assigned to other districts report for work in his district, they will be permitted to go to work, but a report will be made to the Snow Office, giving the serial numbers of the trucks so employed. When the work requires changing from one dump to another, he will give the necessary orders, and will then see that the change is made as he has ordered.

On each visit that he makes to where each gang is working, he is required to make a memorandum of the number of trucks and men employed with each gang.

Four hours after the contractor has received notice to commence the work of snow removal, he shall see that there shall be employed in each gang at least fifteen vehicles with drivers and two laborers exclusive of drivers for each vehicle. This provides an adequate force for promptly loading the trucks.

The District Superintendent is required to report by telephone to the Snow Office at ten a.m., at two p.m., and at the conclusion of the day's work. If he is employed at night, he will make his reports at ten p.m., at two a.m., and at the conclusion of the night's work. He is required at all times to assure himself that all records are correct and that all reports are complete before they are forwarded to the Snow Office. All tickets must be accounted for at the close of each day's work. The total number of tickets issued to the drivers in the district should equal the number of trucks employed, and the difference between issued to loading foremen and these turned should be equal to the number of trucks employed. The District Superintendent is required to make out daily a written report of the day's work which must be forwarded to the Snow Office by eight o'clock on the morning of the following day. With this report must also be forwarded all cards of assigned employees correction cards and other records that are required. Before leaving the district headquarters each day he is required to sign the blotter.

The District Snow Inspectors, upon receipt of orders, are required to relinquish their duties with the snow fighting force, reporting to the snow removal district headquarters to the District Superintendent, who is the immediate superior officer. He then signs his name in the blotter, also recording the hour of arrival. He then receives from the District Superintendent the quota of punches and punch exchange cards to be used in his district. In taking up his duties, the district snow inspector issues a punch to each loading foremen and one to each dump foreman before they leave for their respective posts of duty, and on the punch record card he notes accurately the time of issue, recording the punch symbol by punching the card and requires the foreman in each case to sign his name. All the punching and writing is done in proper spaces provided on these cards.

The district snow inspectors will, at least twice each night or day shift, change the punches and follow the procedure in each case just as in original issue. The location of the gang will be noted by him in the proper space as provided on the cards. He makes out the punch exchange cards in duplicate and delivers all duplicate cards at the end of each day's work to the finance inspector.

In making his rounds, it is his duty to at all times render every assistance to the district superintendent and to that end he is required to familiarize himself with the duties of and the instructions for the district superintendent, the leading foremen and the dump foremen. In the absence of the district superintendent, the district snow inspectors are required to assume charge of all snow removal work in the district.

At the end of his tour of duty he collect all punches and delivers them, together with the punch exchange cards, to the district superintendent, giving the latter all assistance possible in the preparation of reports. Before leaving he is required to sign the blotter. The procedure as outlined is repeated on each successive tour.

The loading foremen, when called for snow removal work, are required to report at the hour designated, or as soon as possible, either before or after this hour, at the headquarters of the district superintendent to which they are assigned. Upon arrival at the headquarters, they are required to sign the blotter, and then they are given their allotment of truck tickets, a punch and an indelible pencil. He then proceeds to the loading point of the gang which is assigned to him, and when a truck arrives at his station, he is required to observe the following rules and regulations:

1. Observe the load to see that the truck is loaded to its maximum heaped capacity. If the truck is not fully loaded to such capacity, it is his duty to send it back to the gang which loaded it, where it must get a full load.

2. See that the serial number of the Bureau of Weights and Measures is attached upon the side of the truck. If the truck does not have a serial number attached, he will direct the driver thereof to the measuring station.

3. Issue tickets if the truck is fully loaded and has a proper serial number attached on the side, observing the following procedure.

A. Enter upon the stub in the ticket book in the space provided, and with an indelible pencil, the serial number of the truck, which will be the number given it by the Bureau of Weights and Measures.

B. Upon the original of the triplicate ticket only, write clearly in the space provided, the owner's full name.

C. Tear out the whole ticket along the perforated line, leaving the stub in the book.

D. Punch the month and date.

E. Punch in the space provided on the ticket, the serial number of the truck. Exercise the greatest care in doing this, and observe explicitly the following directions: On the bottom line, punch the letter on the ticket that is the same as the one on the Bureau of Weights and Measures ticket on the side of the truck. On the next line above punch the left-hand integer or figure of that serial number. On the next line above punch the next integer or figure to the right, punching in each successive upper line until when reading upward on the ticket the number will read the same as the number of the ticket on the truck. Observe that on the ticket no two integers or figures will be punched on the same line, and that no line is skipped between the first line punched and the last line punched.

F. Care must be exercised in punching the time when the truck is loaded. Punch out the nearest division of time on the loading side. If the truck is loaded at 9:20 a.m., the twenty in the minute column on the same line with the hour column is punched out.

G.** Hand the whole ticket to the truck driver, who must remain on his truck while his ticket is being punched.

H.** Tell the truck driver that the tickets are void unless properly punched, and that the loss of a ticket will probably result in the loss of payment to the truck owner.

I. Tell him where to dump, and that when dumping his last load he shall hand his ticket to the dump foreman.

The foregoing instructions are for the first load carried away each day by each truck. On successive loads made by trucks with tickets issued by him, he punches the tickets observing, however, that the serial numbers on the ticket and on the truck are the same, and that on each trip the truck is fully loaded, and that the ticket has been punched at the dump for the previous load.

He will not punch any ticket not issued in the gang of which he is the loading foreman. If trucks are ordered from another gang to report to his gang during the day, he will issue new tickets to such drivers. Should trucks with serial numbers assigned to other districts report for work with his gang, he will permit them to go to work, but will make a report to the District Superintendent, giving the serial numbers of trucks so employed.

He will notify the district superintendent at once should the capacity of any vehicle in his gang be diminished by changes or alterations of any kind, such as the removal of sideboards, after the serial number has been attached, but will punch the ticket for such altered trucks, and permit them to continue at work. He will confirm his report to the district superintendent in writing.

The punch marks in the loading and dump columns form the basis upon which the city makes payment to the contractor, and also part of the record which shows how long it takes to go from the loading point to the dumping point, how many trips the truck makes and how many hours the truck is employed each day.

He must always see that the serial number of the ticket corresponds with the serial number on the truck, and that the time and date is correctly punched. Should he make an error in punching, he is instructed to make a circle around the wrong punch mark on the original, duplicate, and triplicate tickets and then punch correctly. A memorandum is taken of the ticket wrongly punched and written explanation made on a form provided for this purpose when he returns to the district headquarters. Upon the conclusion of his day's work, he will return to the district headquarters, turn in all unused tickets to the district superintendent and return the punch to the district snow inspector. He will then make out written reports as required, sign the blotter and report to the district superintendent when leaving.

*Assistant Loading Foremen.*—When called for snow removal work, each assistant loading foreman will report as soon as possible, or at the hour designated, to the district superintendent at the headquarters of the district to which he is assigned.

He is required to sign the blotter upon arrival, and then proceeds to the loading point of the gang that is assigned to him.

Each assistant loading foreman is instructed to assist the loading foreman of the gang to which he is assigned, and is under the orders of the loading foreman. He relieves the loading foreman, when necessary, for short periods of time.

He counts the laborers at work, and is in position at all times to report to the district superintendent and the district snow inspector regarding the number of trucks and the number of men that are being employed on the work in his district.

He is required to familiarize himself with the duties of the loading foreman so that in case of emergency or necessity he may act in that capacity as required. He is also especially charged with the handling of all trucks so that there will be no confusion or undue interference with traffic, and it is one of his duties to see that trucks are not permitted to load at any point not included within the area assigned to the gang.

At the start of each day's work the trucks are loaded faster than the loading foreman can prepare the tickets, and it is important that these trucks be lined up clear of the traffic after they are loaded to await their turn.

He co-operates in every way possible for the expedition of the work with the foreman employed by the snow removal contractor. He is also required to report any drunkenness or disorderly conduct on the part of any of the contractor's employees.

At the end of each day's work he reports at the district headquarters to the district superintendent and signs the blotter before leaving, returning at 6:00 a.m. on the following day unless otherwise ordered by the district superintendent.

*Dump Foremen.*—The dump foremen are required to report at the district headquarters to the district superintendent when called, or at any hour designated, and sign the blotter immediately upon reporting. They then receive from the district snow inspector a punch and an indelible pencil, after which they go to the dump ready for their work.

The dump foreman, upon arrival at the dump, makes an inspection, and if he finds that it is not in proper condition, or that it is obstructed, or that the trucks cannot be dumped for any reason, he reports these facts, together with the conditions, to the district superintendent at once. When the trucks begin to arrive, he is required to keep them in line and in order so that there will be no confusion and no congestion. He must, at all times, see that the contractor keeps the dump clear of snow and ice.

If the dump foreman is stationed at sewer dumps, he is instructed to obey the orders of the inspector of sewers as relates to the use of sewer dumps, unless he is ordered to do otherwise by the district superintendent, and he is also required to observe the special instructions relating to the use of sewers which are designated as dumping sewers or as shoveling sewers.

Loads of snow may be dumped directly into sewers designated as dumping sewers, but must be dumped alongside those designated as shoveling sewers, and then shoveled into the sewers at a uniform rate which will not clog the sewer.

The dump foreman will permit only trucks that are loaded to their rated capacity to dump, and all trucks which are found to be underloaded will be ordered to return and secure a full load before they will be permitted to dump. He is required to stand at a point close to the dump, where he will be able to see all loads coming to the dump, as well as all trucks which leave the dump after they have deposited their load. Upon the delivery at the dump of the first full load by a truck, he time discharged on the dump side of the ticket, and if the serial number on the side of the truck. If these numbers do not agree, he will tell the truck driver to return to the loading foreman to have his ticket corrected. When he has verified that the truck has been fully discharged, he will punch out the time discharged on the dump siede of the ticket, and if the serial numbers agree, he signs his name on the back of the original ticket and returns it to the driver, telling him to deliver the ticket on his last trip to the dump.

The dump foreman punches the ticket on each successive trip of the truck to the dump, and he must always be careful to observe that the truck is fully loaded when it arrives, is empty when it leaves, and that the numbers on the truck and the ticket agree. It is important for him to always note that the ticket has been properly punched for the load at the loading point.

After the last load from each truck has been delivered, and upon receipt of the truck ticket from the driver, the dump foreman separates it into three parts. He keeps the original, delivers the duplicate to the finance inspector, and gives the triplicate to the truck driver. Then, after the last truck has delivered its last load, he returns to district headquarters and together with a finance inspector, carefully counts the number of loads punched on each ticket and records this count on the blanks provided for this purpose as well as the total number of loads that have been delivered at the dump, afterward making such written reports as may be required.

After delivering his punch to the district snow inspector and all original tickets to the district superintendent, he signs the blotter and leaves, to report at 6:00 a.m. the following morning unless otherwise ordered by the district superintendent.

RULES AND REGULATIONS FOR DUMPING SNOW INTO SEWERS.

1. Sewers designated for the dumping of snow may be used in two ways, namely,

(1) By dumping loads of snow directly into any manhole which has been designated for dumping.

(2) By dumping snow alongside and shoveling it at a uniform rate into a manhole which has been designated for shoveling.

2. Before permitting the use of any manhole for the dumping or shoveling of snow, it shall be examined for physical defects, and the depth and rate of flow of water through the sewer at the particular manhole. If the flow is obstructed or the manhole is defective in any way, dumping shall not be permitted until the district superintendent of sewers has been notified and his consent obtained.

3. Dumping shall never be permitted at manholes not included in the list furnished by the Department of Street Cleaning and approved by the engineer in charge of sewers.

4. An open sewer manhole shall never be left unguarded.

5. Whenever a manhole cover is removed, it shall be placed on the sidewalk from which the snow has been removed, where it can be readily found and replaced as soon as the dumping into that particular manhole is discontinued.

6. All snow deposited in sewer manholes shall be free from sticks, stones, solid ice, cans, ashes, garbage, or other material which would injure or obstruct the sewer in any way. This is most important and must be strictly watched.

7. Keep careful watch of the sewers and do not allow them to choke from too rapid dumping of snow. When continuous dumping directly into the manholes is found to choke the sewer, such dumping shall be discontinued until the sewer has resumed its normal condition and is determined to be free from snow or any other obstructions that may have lodged. The depositing of snow into the sewer may then be continued, but the trucks shall be required to dump their loads beside the manhole and the snow shall then be shoveled into the sewer at such a rate as will guard against further clogging of the sewer.

8. Whenever a manhole has been designated for the use of shoveling, all trucks shall dump their loads beside the manhole, and it shall then be shoveled into the sewer at a continuous and uniform rate which shall not be so great as will choke or obstruct the sewer.

9. Whenever it is found that shoveling snow into a sewer obstructs the contents of the sewer to such an extent that the snow is not quickly carried away, the shoveling shall be discontinued until all snow already in the sewer shall be carried away and the normal flow of the sewer has been resumed. Shoveling may then be resumed, but it must be at a slower rate so as to not again obstruct the sewer.

10. Wherever the dumping or shoveling of snow repeatedly obstructs the sewer, the district superintendent of sewers shall at once be notified and he shall then decide whether or not the use of such a sewer or manhole for the disposition of snow shall be discontinued. All directions and instructions given by the district superintendent of sewers shall be explicitly followed and carried out, and all such directions shall be reported as soon as possible to the district superintendent of snow removal.

* * *

## Report of the Committee on Resolutions of the American Road Builders' Association

*Resolved,* That this Association expresses its appreciation of the cordial welcome extended to it by his excellency, the Governor of the State of Pennsylvania; his honor, the Mayor of Pittsburgh, and the Pittsburgh Chamber of Commerce.

*Resolved,* That this Association extends its sincere thanks to the State, county, and city officials, the commercial organizations of the city, and especially to the Pittsburgh Chamber of Commerce for its very delightful theater party, and the Pittsburgh Automobile Club for its very enjoyable automobile ride, as well as the different organizations which are devoting their attention to road improvement, for the many courtesies extended by them, all of which have contributed so conspicuously to the enjoyment and profit of those in attendance at this convention.

*Resolved,* That this Association hereby expresses its appreciation of the valuable co-operation of the manufacturers, States, cities, and others who have, by their excellent exhibits, contributed so greatly to the value and instructiveness of this convention.

*Resolved,* That this Association recognizes the value of the work done both by the local and general press in disseminating information regarding the convention, and it hereby tenders its thanks for the same.

*Resolved,* That this Association invites the attention of all State, county, and all municipal authorities to the value of traffic censuses as a means of recording and determining the relative values of various forms of pavement and road construction, and would strongly recommend that systematic traffic censuses be taken from time to time on all classes of roads and pavements in order that more definite knowledge of the economic value of the different types of construction may be obtained.

*Resolved,* That in taking such censuses, separate counts should be made of horse-drawn vehicles, light and heavy, and of motor vehicles, classified as pleasure and commercial cars, with notes as to the use of especially heavy trucks and vehicles with tires especially injurious to roads.

Where it can be used in order to obtain comparable information, the standard form for taking traffic censuses reported by a committee of the American Society of Civil Engineers is recommended.

*Resolved,* That where funds for road construction are raised by an issue of bonds, this Association urges that the serial form of bond by which a part of the principal is paid off each year, be adopted in preference to bond issues to be paid by accumulations in a sinking fund.

*Resolved,* That this Association urges that laws be passed and enforced in each State establishing reasonable limits for the weight, dimensions, and speed of heavy motor vehicles.

*Resolved,* That in the matter of military preparedness a system of properly located and improved roads is of vital importance.

*Resolved,* That this Association heartily congratulates the city of Pittsburgh, county of Allegheny, State of Pennsylvania, and the public in general upon the fact that the people of this country and Canada are realizing the importance and the value of good roads and are showing as much interest in the best methods of their construction and maintenance as is evidenced by the attendance at this convention.

(Signed) George W. Tillson, Chairman.
Charles Whiting Baker.
W. W. Crosby.
Fred E. Ellis.
F. E. Everett.
W. A. McLean.
James H. MacDonald.
R. L. Morrison.
W. D. Uhler.

# Report of the Committee on Resolutions to the Second National Conference on Concrete Road Building

## Chicago, February 18, 1916

**Resolved,** that this Conference expresses the opinion that a third Conference should be held. And be it further

**Resolved,** that the Advisory Committee be continued with full power to make all necessary arrangements for such future Conference, to fix the date, to make such changes in its membership and organization as it may see fit, and to delegate its powers to an executive committee.

**Resolved,** that the Second National Conference on Concrete Road Building, assembled in Chicago, February 15-18, 1916, reiterate the statement of the previous Conference, that it is highly desirable that the materials available in the various States for use in concrete be examined and tested as rapidly as possible by competent State geologists, universities, or engineering experiment stations; and be it further

**Resolved,** that the Governor and the legislature of the several States be provided with a copy of these resolutions and asked to seriously consider the great necessity for making adequate provision and appropriation to the proper agency for the prompt inauguration of such investigations.

Your committee has held frequent meetings and devoted much time and endeavor in the attempt to crystallize the thoughts and recommendations presented in the several reports and developed in the discussions thereon, and appends herewith the results of its deliberations in the form of recommended practice for the construction of concrete roads, and recommends that the same be adopted as the opinion of this Conference.

### CONCLUSIONS OF THE CONFERENCE

Field for Concrete Roads.

Owing to the increase of population, the travel upon rural and suburban roads and city streets has increased rapidly in recent years, and this increase in travel, together with the introduction of the automobile, has necessitated the development of a new type of road surface. Formerly, macadam or broken stone roads were extensively used; but the increase in volume of travel, and the new conditions imposed by the automobile, have made the cost of maintaining such roads so excessive as to make them, in many cases, an impossibility from the economic standpoint. The concrete road is admirably adapted to meet present-day traffic conditions. Concrete roads are moderate in first cost, low in maintenance, smooth, hard, dustless, sanitary, easily cleaned, and not slippery. They are suitable, first, for country highways where the road is subjected to overflow and on hills where storm water necessitates special gutter construction, and where the macadam road surface may be washed away more rapidly than worn away; and, second, for pavements in small cities, for outlying streets of larger cities, and especially for all streets where curbs are not required.

### OUTLINE OF CONCLUSIONS.

The salient features of the practice recommended by the Conference are:

**1.—Drainage of the road bed is vital.**
**2.—Subgrade must be of uniform density and should be compacted.**
**3.—Aggregates must be clean, hard, and tough.**
**4.—Fine aggregates (sand) should be coarse and well graded.**
**5.—A rich mixture must be used.**
**6.—Materials must be accurately proportioned.**
**7.—Mixing must be most thorough.**
**8.—Sloppy concrete must not be used.**
**9.—In general, the use of reinforcement is justifiable.**
**10.—Inspection must be intelligent and thorough.**
**11.—Concrete must be protected from rapid drying.**
**12.—Pavements must not be opened to traffic too soon.**

### RECOMMENDED PRACTICE.

The Second National Conference on Concrete Road Building adopts the following principles as representing good practice in the construction of concrete roads and pavements.

#### I. Materials.

**Portland Cement.** Portland cement shall meet the requirements of the Standard Specifications for Portland Cement of the American Society for Testing Materials, and tests should be made in accordance with the methods of testing outlined by the American Society of Civil Engineers.

**Aggregates.** The selection of proper aggregates for concrete road construction is of utmost importance. Clean, hard, well-graded materials are absolutely essential to success. For this reason, samples of the materials proposed for use should be submitted to the engineer for approval before orders are placed. These samples should be carefully inspected, and if possible, laboratory tests be made upon them to determine their suitability. If laboratory tests on shipments cannot be made, field tests can be used to furnish a general indication of quality.

The different aggregates should be kept clean and separate until used.

Aggregates to be used in the wearing course of two-course pavements should never be placed on the subgrade but on planks, unless some other means is provided to keep them free from dirt. If aggregates are placed directly on the subgrade, care should be used by the shovelers to avoid getting clay or earth, shoveled from the subgrade, into the mix. Aggregates should not only be clean when they are delivered on the job, but clean when placed in the water.

**Water.** Water supply is a most important factor and is frequently overlooked by the engineer and contractor. A large supply of water is necessary for (a) sprinkling the subgrade; (b) mixing the concrete; and (c) keeping the concrete moist during early stages of hardening. For the last purpose, twenty-five to thirty gallons per square yard of pavement will be required during the summer months. Unless sprinkling is sufficient, the wearing qualities of the pavement will not be all they should be.

**Reinforcement.** The use of reinforcement in concrete pavements is increasing. A coating of light rust will not be detrimental to satisfactory results, but care should be exercised that no excessive rust, paint, or other coatings are present to interfere with proper bond. Care should also be exercised to see that the reinforcement is so stored prior to use that it is not coated with mud or clay when placed in the pavement. Reinforcement left on a job when contract is not completed at the end of the season, should be collected and stored so that it will be protected from the elements. Occasional tensile and bending tests should be made to see that the requirements of the specifications are fulfilled.

**Joint Filler.** Joint filler should preferably be of a single thickness. Transverse joint filler should be cut to the crown of the pavement by the manufacturer, when metal plates are used. A type of joint filler which will iron out readily under traffic, is preferable for use in unprotected joints. A joint filler which will not bend easily when concrete is deposited against it is to be preferred.

**Joint Protection Plates.** Metal joint-protection plates should be properly bundled and wired by the manufacturer so that they will arrive on the work in good condition, free from warp. Protection plates up to twenty feet shall be shipped in single lengths. The exact length required should be provided, so that the contractor will not find it necessary to cut plates. In cutting plates for length, spacing between eccentrics on the installation bar should be considered to avoid interference with anchorage lugs on plates. Particular care should be used by the manufacturer in crowning the installing bar, to avoid the necessity of duplication of work by the contractor.

#### II. Drainage.

The drainage of the roadbed is of vital importance. If the subgrade is not well drained, there is danger of unequal settlement or frost action, which will cause cracks. The method of drainage to be used will depend upon local conditions. For roads, proper drainage may be secured through lateral ditches. For streets, as well as roads, tile drains may be used. These should be laid on each side of the roadway, or may be laid on one side only, with cross drains leading thereto at a suitable depth, depending on the width of the pavement. Drainage trenches, if placed under the subgrade, should be completed before final rolling.

#### III. Grading.

When roadways are constructed over fills, extreme care should be observed to insure the use of proper materials in layers of such thickness that the materials may be thoroughly compacted, so that when the fill is completed there will a minimum of settlement. In general, fills shall be made in thin layers, the thickness depending on the character of material to be used in making the fill. The fill should be allowed to stand for as long a time as possible, to give it an opportunity to settle thoroughly before the pavement is placed thereon. Deep fills should be allowed to settle through one winter wherever such procedure is possible. Puddling will be found advantageous in compacting deep fills. Wetting and rolling shall be performed when making a fill in order to secure thorough compactness. Fills should never be made with frozen materials, nor with lumps greater than six inches in their greatest dimension.

#### IV. Subgrade.

The fundamental requirement of the subgrade is that it should be of uniform density so that it will not settle unevenly, thus causing cracks in the surface of the pavement. No part of the work is more deserving of intelligent care and painstaking labor than the preparation of the subgrade. The slight additional cost necessary to insure good results is abundantly justifiable. When the pavement is constructed on virgin soil, care should be taken to remove all soft spots so as to insure a uniform density; and if constructed on an old roadbed, even greater care must be taken to secure uniform density, as the subgrade is likely to be more compact in the center than at the sides. An old roadbed should be scarified, reshaped, and rolled. The subgrade adjacent to curbs should be hand tamped.

#### V. Forms.

Metal side forms of sufficient strength to withstand the necessary hard usage are preferred. When wooden forms are used, they should be of two-inch stock, at least, and capped with a two-inch angle iron, and so constructed that adjacent sections can be lapped. Forms should have a width of not less than the thickness of the pavement at the sides. Particular care should be exercised to see that the top edge of forms is clean so as to avoid unevenness in the finished pavement. If forms are warped or stakes not properly placed, a poor alignment of the edge of the concrete slab will result.

#### VI. Pavement Section.

**Thickness.** The thickness of a concrete road or pavement is controlled by many factors, each of which should be given consideration. In view of the increasing use of the heavy motor truck and bus, it seems unwise to build pavements with a thickness of less than six inches at any point. In general, pavements should be thicker at the center than at the sides. Alleys with an inverted crown, and narrow one-slope roads, should have a uniform thickness. Wherever the thickness can be increased without excessive

(*Continued on page* 41.)

# An Important Quality of Wood for Paving Purposes

By Major W. W. Crosby, Chief Engineer, Maryland Geological and Economic Survey, and Consulting Engineer, Baltimore, Md.

NOT so many years ago, it was a common practice in paving specifications to call for or describe some of the materials by their trade names, and, for the purpose of avoiding the creation of a monoply or of an embarrassing situation by such a specification, to append to such a description the alternative clause "or other material equally good in the opinion of the engineer." Frequently, however, such an alternate created another situation equally embarrassing and the indefiniteness and unscientific character of the clauses were generally recognized. Then the effort was made to determine and describe the essential characteristics of a material known by experience to be satisfactory for the purpose for which it was intended to be used, and by such description in the specifications, to insure the delivery of a material regardless of its name which would be sufficiently like the particular material in question to be satisfactory to the highway authority and the needs of the occasion. Such a course also seemed to offer a more rational method for the engineer, or other referee under the contract, to convince every one of the equalities or inequalities of the materials offered.

Quite naturally perhaps, engineers, who have become accustomed to the use of a particular brand of material, felt obliged, in abandoning the use of the brand as a means of description of the material desired, to be on the safe side in their substitution of a more technical description, and often they were assisted along the lines of this tendency by their chemical or other advisers, particularly when none of the parties could be positive as to just what elements entered into the production of certain facts, apparently considerable, in the use of the material for the specific purposes of paving.

For instance, take the case of bituminous materials. Up to six or seven years ago, but few such materials were generally on the market, their characteristics were fairly well known, and their specification was usually by a trade name as at first described, according to the personal views and experiences of the engineer in character of any particular case. Quite suddenly, there was a demand for similar materials differing in many respects from the common products referred to, and this demand was met by a prompt supply of greatly varying materials from both the older sources of supply and from newly developed ones. The accurate description of just what was wanted in any particular case was necessary, and the insufficiency, as well as the impropriety of the older method of description became evident. Thereupon, detailed descriptions of the various materials were put forth. Many of them were so complicated as to be objectionable for many reasons. The simplification of these complex descriptions, when attempted, was found sometimes to be difficult because of the lack of knowledge as to the effect that would be brought about by the omission of condensation of some of the clauses. There may often have been a resistance to simplification brought about by the realization of the want of definite knowledge of many points and by the desire to accelerate research work and The accumulation of definite knowledge through the opportunity offered by such specifications.

Perhaps the first important instance of departure from the older form to a more rational form of specification for a material was in the case of hydraulic cement. Here, a relatively simple compound had to be described, and it was quickly settled that a few physical tests supplemented by one or two chemical ones were all that was necessary to insure the delivery of a proper article. There may still be some question as to the necessity for all the tests now commonly required on this material, but in the main its description has been satisfactorily standardized.

The same general line of action appears to have been, or to be being followed with many other of the paving materials in use. The main objects of this paper are to call attention to the lagging behind, in some respects at least, and as it appears to the writer, in the case of specifications of wood blocks for paving purposes and to suggest for consideration and discussion among those interested, the possibility of a considerable improvement in the now customary specifications for this material.

The specifications for wood blocks have generally to date prescribed that the material should be "long leaf yellow pine" (pinus palustrus) or other wood equal thereto in the opinion of the engineer (with occasionally an alternate wood mentioned by name); that the growth rings should be in number between certain limits per inch, and that the blocks should be within a certain maximum limit of variation from size, percentage of knots, checks, and other defects. It is of course prescribed that they shall be treated with a preservative whose characteristics and use are described more or less carefully, but for the purpose of this paper, the discussion will be confined to the specifications referring to the description of the wood itself.

It seems to the writer that, exactly as in the cases of hydraulic cement and of bituminous materials, it is not only entirely possible to improve on these specifications for the wood to be used, but also that it is extremely desirable, for many reasons, that this should be done. He proposes to suggest one way in which he thinks the end may be reached.

The object of the old specifications naming the wood to be used and describing limits for the variations of this particular wood, seems to have been to secure a grade of material which it was felt experience had demonstrated would be capable of proper impregnation by a preservative and when so impregnated by the preservative and laid in the roadway, would be neither too soft to wear objectionably, nor too hard ordinarily to be slippery under traffic. Now, may not both of these ends be secured by a single specification which shall properly describe and place limits to a quality of wood, which, for want of a better term, the writer will call its "consistency." Perhaps the term resiliency would be more accurate, but there may be some discussion on this point, and as authorities do not seem to be agreed as to a definition and measure of the resiliency of wood, the somewhat broader term—consistency—seems to the writer more satisfactory for the present.

The writer believes that an assumption may be made here to the effect that, under the same conditions as to preservative and treatment, the harder the wood, the less of the preservative absorbed and vice versa; also, that hardness and softness are merely colloquial expressions for degrees of consistency, purely relative and by no means definite. Again the writer thinks it will be generally agreed that an extremely hard wood paving block is likely to prove objectionably slippery in the roadway, while too soft a block does not show sufficient resistence to wear, and that a desirable block is one which will come in consistency—that is, in hardness or softness of wood—somewhere between the limits of the hardest permissible without slipperiness and the softest permissible without excessive wear. It is therefore a measure of hardness or softness—that is, of consistency—which will determine the kind of wood to be permitted for use in any case, and if a means for measuring this consistency and a scale of consistency shall be adopted, there will then be no further need for naming the kind of wood to be used, and quite probably no need of going into detail in the specifications concerning the number of rings to the inch in the different kinds of wood. The resulting specifications will therefore be less subject to criticism on the grounds of containing too large a personal factor, of being too indefinite, or of being unnecessarily narrow and "closed," such as is the case when it is stated that another kind of wood than that specified will be accepted if "equal in the opinion of the engineer" or when a single kind of wood is specified, or when the count of rings is limited too narrowly.

Some attempts have been made along different lines toward establishing a measure of consistency. The United States Forest Service has done some research work and published some conclusions along this line. The Case School of Applied Science, Cleveland, Ohio, has also had some work done under its supervision along related lines.

The writer's opinion as to the general value of a consistency test on paving materials has been perhaps sufficiently set forth in his paper on "The Consistency of Bituminous Materials" printed in Engineering and Contracting for February 5, 1913, page 152, and in The Surveyor (London) for March 7, 1915, page 425, to need no repetition here. Those interested

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to secure it in detail may do so by referring to the publications just given. The writer would say that generally the remarks there, may, he believes, apply equally well to wood when the necessary changes in substantives are made.

Considering now a consistency test for wood and referring to the above mentioned work of the U. S. Forest Service, it will be found that this Bureau in its circular 38 (revised), entitled "Instructions to Engineers of Timber Tests," refers on pages 22 and 23, to certain tests for compression, and again on page 24, to an impact test. The latter test is used to determine the relative brittleness of different woods. In a circular (No. 213) subsequently issued by the Bureau on "The Mechanical Properties of Woods Grown in the United States," is given a table on the results of a number of tests included in which is a test for hardness, and the figures given under the head of this test are stated to be those of the load in pounds "required to imbed a 0.444 inch ball to one-half its diameter." In the same table are also given figures for the results of the compression test and the impact test, which it should probably be stated now is the bending under impact and not the rebound of the impacting tool. None of these tests seems to the writer to measure directly the quality of the wood he has in mind—that is, its resiliency or consistency—though perhaps they all, more or less indirectly, throw some light on this quality, and the results of these tests may in some cases be more or less directly related to the results which would be secured from a more direct test of this quality. Under the impact test, and up to the point where permanent deflection takes place, it might be said that the resiliency of the wood—that is, the ability of the wood to return to its normal position after distortion, was indicated, but this ability in a beam may be quite different from the ability of a portion of the area of the wood to resist displacement or to return after displacement. With wood paving block, which seldom, if ever, are obliged to act as beams, it is the resiliency of a small area which is critical.

The hardness test is described by the Forest Service as the measurement of the force required to produce a definite amount of displacement of the wood fibres. This is not the critical feature in wood paving block. With them, it is rather the ability to resist displacement of or for the fibres to react and to return to their normal position after a strain tending toward displacement has been undergone by them. Perhaps a slight modification of the hardness test described might answer the purpose. That is, if the steel ball (or a cube) should be loaded with a specific weight less than that required in any case to produce permanent displacement of the fibres, and the application of the force made for a definite period, the maximum displacement being measured at the end of that period while the force was still applied, and then the force removed and the amount of restoration, toward their original position, of the wood fibres measured by determining the difference in position of the ball or cube before and after the removal of the force, the end desired would be reached, and the elasticity, resiliency or consistency of the wood thus determined in a way which would throw considerable light on its suitability for use as a a paving block.

The writer is not aware of how much research work along this line may have been done, but he hopes that it is considerably more than his knowledge at present covers. It is with a view to bringing out such information as is available along this line, as well as for perhaps suggesting an investigation of value in this connection, that he submits this paper.

Reference has been made to the desirability of securing a wood which would be capable of proper impregnation by a preservative and it may seem that in the foregoing, too much consideration has been given to the consistency of the wood alone and that this matter of impregnation has been neglected. When a specific test for consistency shall be developed, the writer hopes that it will be found that the capacity of a wood to absorb the preservative is related to its consistency within the limits of the latter suitable for specifications in the cases of wood pavements. He admits that the information on this point in his possession is incomplete at present. Whether or not, however, the fact hoped for shall be established need not interfere with the establishment of a proper test for the consistency because this having been established, it will then at most only be necessary to supplement it with another determination as to the capability of the wood for absorbing the preservative.

## Notes on the Construction and Care of Earth, Gravel and Macadam Roads

By H. E. Bilger, Road Engineer, Illinois State Highway Department, Springfield, Illinois

IN seeking advisable methods of procedure in the construction and care of earth, gravel, and macadam roads in rural territory in Illinois, it is necessary to disregard largely the practice that heretofore has been prevailing, and to keep very closely in mind the actual requirements of present traffic. Inasmuch as there was a time when this practice was duly warranted, it will be well to recall briefly the former conditions that fostered the old methods of constructing and maintaining these roads in order to more clearly appreciate the changed conditions as now existing.

When these methods were first inaugurated the country was very sparcely settled and the land was unimproved. This sparce population had very little occasion for traveling more than just a few miles from their homes, and even when such occasion did arise the financial conditions were such as to prohibit any considerable amount of traveling on the public highways. Owing to the fact that ready cash was not freely in circulation for the payment of debts, the labor system grew up and became almost universally adopted as the system whereby the roads were constructed and maintained. This labor system then, of paying road taxes has grown up from the condition, that labor was plentiful and not readily exchangeable for cash.

In addition to this, vehicle facilities for travel on the highway were such as to necessarily confine this travel within a comparatively small radius from the home. Because of there being so little inter-communication among the people, their knowledge of affairs in general remained limited almost by their own individual experiences. These experiences make for the accumulation of general knowledge at but a very slow rate indeed, for the repetition of error, due to the absence of opportunity to profit by the experience of others, fosters a condition that is practically stagnant. It is most striking how these conditions harmonize with the idea of the small political township being the governmental unit for the administration, construction and maintenance of the principal public highways.

Instituted by these early conditions and continuing up until even recent years, the rural road improvement that has been carried on in Illinois has been of such a character as to attempt to satisfy the needs of only the immediate present and within a very small local community. Year after year the annual tax levy, both labor and cash, has been expended in an ill-directed and piece-meal fashion in perfect harmony with the original practice of working the roads, and almost to the utter disregard of the requirements of traffic. The work has been so light, so scattered, and of such a temporary character that no small portion of the total funds expended has gone for administrative purpose.

In many cases creditable attempts have been made locally toward the proper improvement of the highway, but owing to the insufficiency of funds to carry out the work economically, and also to the small size of the township as the administrative unit, the results have been anything but what would represent work that was directed in a systematic manner and in accordance with a well-conceived plan. It could not be expected, of course, that modern ideas and methods of solving the road problem would be inaugurated under conditions that were not conducive toward their practical application.

In contrast with these earlier conditions let us briefly consider the ones existing to-day. In the first place, both the urban and the rural population have become comparatively dense, and consequently there has come about a corresponding increase in the price of real estate. Instead of there being ample farm labor for road work as formerly, such labor has become very scarce and the tax-payer, as a rule, prefers to pay his road taxes with cash and to convert his labor to more profitable fields of activity.

Money has come into circulation more freely than heretofore, and as a result people have been afforded more or less opportunity for traveling within a larger circle in their neighborhood, and thereby accumulating such knowledge about modern improvements as can be obtained in practically no other way. In addition to this, it must be appreciated that vehicle

facilities for travel on the highway have become entirely revolutionized within recent years. These facilities broaden still more the range of general knowledge of the community at large.

The situation presented by these new conditions is that the general public is no longer concerned with the material welfare of merely the one township in which they reside, but their interest extends as well throughout the adjoining townships and, in many cases, even the adjoining counties. While there still remain many lines of activity that are matters strictly local to the township, and consequently should be administered by township officials, yet public improvements have become of such a character as to concern most vitally those living entirely without and at some considerable distance from the township immediately concerned. The improvement of the public highway for example, represents a constructive problem that much concerns a great portion of the residents of one or more counties.

There having recently sprung up such demand for highway travel facilities as cannot economically be satisfied by the old system, it is but logical that the township should no longer have jurisdiction over the administration, construction, or maintenance of the principal highways. As the plane on which we live and the methods by which we travel are changed from time to time, there must come about a corresponding change in all matters relating to the public highway.

Legislators have recently appreciated this fact and have accordingly enacted laws whereby the county as the administrative unit shall have jurisdiction over such of the highways as appear to be of most concern to the public at large. With the county as the governmental unit there is offered such opportunity as to upset entirely the old-time practice, and to provide at a reasonable expense modern roads of a quality that will adequately satisfy the needs of public travel throughout the entire year.

In constructing either a gravel or a macadam road it is necessary to construct properly an earth road first, and consequently the earth road will be considered. The distinct features that should inhere in an earth road improvement are practically identical with those that now characterize our practice in the construction of hard-surfaced State-aid roads. These features collectively constitute the fact that a properly constructed earth road needs only the addition of the metal surface to be converted into a quality of construction that will satisfactorily meet the requirements of modern raffic.

Earth road improvement consists of three operations, namely, bettering the horizontal alignment, building the drainage structures, and doing the necessary grading. These three items of work are done in the order named, and for all practical purposes they may properly be termed permanent improvements. The completed earth road should conform with respect to alignment, drainage, etc., to the corresponding features of the most modern hard surfaced roads now being built in Illinois. In other words, the only additional expenditure to convert the earth road into a modern hard-surfaced road is the amount necessary to provide in place the 10, 12, 15, or 18-foot width of road metal or wearing surface.

In the recent revision of the Illinois Tice Road Law the Legislature has seen fit to speak of permanent earth roads, while to the various types of surfacing material for the earth road-bed there has not been made any mention regarding the probable life of the work. This matter has been the occasion of provoking some rather humorous comment upon the part of those familiar with the behavior of the Illinois soils when saturated with water. *Upon a second thought, however, it will be appreciated that the term "permanent" can more properly be applied to an earth road than to any other type that has yet been devised. With whatever materials we may choose to construct the wearing surface on the earth road, the fact remains that the life of this surface is of but a temporary character as compared wih the life of the roadbed formed by old mother earth underneath.*

In considering the life of an earth road it would be very superficial, indeed, to consider only the physical condition of the upper few inches of the road surface. With satisfactory original construction the condition of this surface is dependent upon faithful maintenance, while the earth road as a type in itself consists more properly of the horizontal and the vertical alignment, the width of graded roadway, and the angle of side slope for cuts and fills. As the improvement in these respects is made to conform to the requirements of both the traffic and the action of the elements, it will be appreciated that in no other character of work does there prevail the inherent permanency as when a volume of earth is taken from where it will never be needed and put where it will always be needed.

Once the earth roadway is practically completed the operation of applying the gravel or macadam wearing surface requires a serious consideration of the traffic conditions, the availability and the character of the materials, and the funds available for the work. The metel-wearing surface usually represents the greater portion of the total expenditure, and also the portion of the improvement that is susceptible to changes in either the character, volume, or distribution of the traffic. For this reason, the cost of the wearing surface should be considered in terms of the construction cost, the interest cost, the maintenance cost, and the depreciation cost. Both the absolute and the relative weights to be assigned to each of these four costs are so dependent upon the local conditions that a complete analysis is required for each individual case.

The adoption of the gravel surface is usually prompted by considerations of lower construction cost due to the supply of material being readily available nearby. The ease of handling, spreading, and rolling this material also contributes to this lower cost with the result that as the total construction cost is kept low, the interest cost is kept proportionately so. The advantages of a low construction cost are numerous. Should the type not have been selected with wisdom, or should a new and unforseen traffic condition have developed, the lower the original construction cost, as a rule, the better prepared will the community be to build to satisfy the new requirements. This lower cost also tends to meet the ever pressing public demand that the length of the improvement be extended to reach at least the next farmer's property.

In the maintenance cost also does the gravel road usually rank ahead of the macadam, due not only to the lower cost of additional materials, but also to the fact that the labor item is smaller. Practically all of the rural conditions prevailing where gravel roads are economical are more favorable toward the maintenance of these roads with teams and road drags than they are toward the maintenance of macadam roads by hand labor and the use of small tools. For this reason, the labor is usually less expensive per unit area for gravel road maintenance than for macadam.

In prolonged periods of hot and dry weather the gravel road will nearly always prove to be more serviceable than the macadam road. On the other hand, it will often rupture and disintegrate under the stress of external forces while the macadam road will be preserved in its integrity by the mechanical bond. However, where the cost per unit volume of the gravel at the job is lower by an appreciable figure than the cost of crushed rock, the relative merits of the two types can be disregarded and the gravel type should under usual conditions be adopted.

The advisability of either gravel or macadam road construction varies with factors other than construction cost and the relation of the traffic features to the serviceability of the type. Whether the improvement is the first of the general character in the community, or merely an addition to a system of hard roads already existing, figures largely in the maintenance cost of the road. Under the latter conditions, the burden coming upon the improvement would in all probability be no greater than the road could withstand; while under the former, the volume of traffic to which the road would be subjected might in a few months reach a figure that would warrant concrete or even brick construction.

The general character of the soil for the shoulders and on the nearby roads may also have a bearing upon the virtual cost of the type constructed. Sticky and gummy soils on shoulders and side roads seriously increase maintenance costs on gravel and macadam roads. These costs are further increased as the number of private entrances to farms and fields are increased.

The proper improvement of a highway necessarily requires that there be constructed many small culverts and bridges that at present are either worn out or are improperly located. These drainage structures, as well as the provision for under-drainage, should be cared for at the time and in conjunction with the other improvements. Under Illinois conditions all culverts, and also all reasonably small bridges, should be built of

concrete. The cross culverts should be designed with a clear roadway varying from about twenty-four to thirty feet, depending upon the importance of the road being improved.

All side culverts leading to side roads should be provided with a clear roadway varying from about twenty to forty feet, and those leading to private farm entrances should have a roadway of not less than 16 feet. For these latter structures it has been learned from field experience that generally the most economical procedure is to imbed ordinary farm drain tile in a four-inch concrete base, and then surround the tile with about four inches of concrete. The cost of farm tile for this purpose is considerably more than met by the saving that results from doing away with the necessity for building forms for the concrete, and for the subsequent removal of these forms.

MAINTENANCE.

The fact of road construction being completed does not mean that the problem is solved. Gravel, macadam, and all other types of hard roads as well as earth roads require maintenance, the difference being chiefly a matter of degree and of character of work required. The three distinct systems of maintenance usually recognized are the intermittent, the patrol, and the gang systems. For each of these systems there is a proper field, and no one of them alone is perfectly applicable under all conditions for a given type of road.

Under the intermittent system the work on a given section of road is done by one or more men only at such times as the condition of the road requires. That is, no periodical schedule for doing the work is adhered to; but instead, the labor forces are called into action at any time the condition of the road requires that the work be done. This system exclusively is applicable only for more or less unimproved roads upon which there is a comparatively small amount of travel. Some conditions that foster the use of the intermittent system are a sparce population, a low type of road, and availability of ordinary labor. It will be noted that from the very earliest times this system of road maintenance has been in vogue in Illinois.

Up until recently the conditions in general have been such as to warrant the use of this system, but as these conditions gradually pass away it is necessary that the system give way to the adoption of one that is designed to meet the new conditions. The intermittent system will not be abandoned entirely, however, for the third-class roads of almost every township constitute such a large mileage and accommodate so little traffic that even under our modern conditions this system, if properly administered, will undoubtedly continue to prove economical.

The application of this system of maintenance to the earth road consists almost entirely in keeping the weeds cut down and in dragging the traveled portion of the road; provided, however, that in the original construction adequate provision was made for surface and for underground drainage. Efficient earth road maintenance requires that the entire length of the work be divided into comparatively short sections, each section being in charge of some individual with ample authority and corresponding responsibility. It is usually uneconomical to maintain earth roads by any system other than the intermittent one. The very detail and frequent character of the work required is such as to necessitate that attention be concentrated when needed upon small sections of the road. Where higher types of road improvement are adopted correspondingly larger sections should be put in charge of an individual for maintenance, and, on the other hand, the lower the type of the improvement the smaller should be the sections into which the work is divided.

The patrol system is the recognized practice of maintaining roads by dividing the work into comparatively short sections and having each section in charge of a man who devotes his entire time to the work. This system is especially applicable to the lower types of hard roads, inasmuch as the maintenance work is of such a character as to require one of experience. The system applies especially where the work is rather heavy and where, as is so frequently the case, the traffic requirements are rather beyond the type of road.

The patrol system lends itself naturally to gravel and macadam roads on account of the peculiar character of work that is continually occurring and requiring immediate attention. The use of the drag is very effective for maintaining gravel roads, for the ruts and holes can readily be filled by dragging the displaced gravel into them. A road drag properly used will generally maintain a well constructed gravel road more economically than almost any other instrument. For macadam roads, however, the drag is not equally efficient. Macadam road maintenance requires detailed attention in the defective spots rather than merely a general smoothing over of the entire surface of the road. It is usually necessary to keep supplying fresh material instead of merely re-shaping with the drag the material with which the road was originally constructed.

The gang system is the method of road maintenance whereby a large mileage is cared for by two or more men who devote their entire time to the work. This system is especially applicable to the higher types of roads, as vitrified brick and Portland cement concrete, for the reason that the character of the maintenance work is such as to demand that it be done by experienced hands. The amount of maintenance required on the pavement proper per mile of road is in fact very small, but the work must be of a comparatively high order.

Since the amount of work per mile is so small, it will be seen how under the gang system a large mileage of road can be included in one section. The gang and the intermittent systems combined usually make for more economical results than the gang system alone. The work of the gang is confined to the pavement proper, while the periodical work on the road sides and ditches is done under the intermittent system.

The governing conditions that affect road maintenance are so varied that no one of these three systems can economically be applied to all of the roads in any one county. All of the conditions attending each particular road must be analyzed, and then the particular system or combination of systems adopted that will most satisfactorily meet the requirements of the case. On the third-class roads of the county this work can usually be done most economically by the intermittent system, unless the county is in one of the highest developed parts of the State.

The real road maintenance problem in Illinois for many years to come will consist in dealing with the earth road which constitutes more than ninety per cent. of the entire rural mileage. Without maintenance, it almost ceases to perform the functions of a public highway, but with proper maintenance no other road responds so effectively to the real needs of the traveling public as does the ordinary earth road. Between the present condition of our earth roads and the condition to which they could be brought and maintained by just a little intelligent effort, there exists a gap that is far beyond the realization of the general public. The earth road has never been given even half a chance to make good. With the same opportunity to make good that has been afforded other types of roads, I am satisfied that for a selected seventy per cent. of our total rural mileage, the humble earth road would show up for true serviceability far beyond any type of hard road feasible for Illinois.

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## The Adaptability of Various Types of Pavements for Different Kinds of Traffic as Indicated by Service Tests and Rational Design

By Mr. H. J. Fixmer, Division Engineer, Board of Local Improvements, Chicago, Ill.

GENERAL SITUATION.

THE construction of pavements and roads continues to be in the experimental stage. The nature of traffic is still in a stage of transition. It must be admitted at the outset that very little authentic data exists as to the servicability of the various types of pavements, and this data of only speculative value in designing pavements under modern conditions of use. The meager and fragmentary information respecting adaptability of the various road surfaces has served mainly to inspire invention, experimental construction, and the general improvement of recognized standard constructions.

A pavement giving satisfaction in one locality may prove to be a failure in another. The action of indeterminate and ignored forces, and not "chance" so-called, must be recognized as the cause, and every effort must be put forth by the engineer to determine true values for the significant elements contribu-

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ting to the success or failure of the pavement construction under his supervision.

To follow a borrowed specification blindly discourages rational progress. When real success is achieved, the engineer should publish complete information of the entire construction, nature of traffic and effect of use. Unless all of the knowledge gained can be interpreted and applied it is of little value or service. All the facts must be known and arranged in their logical order. Unless this is done and the relative importance of these facts in affecting the result properly appreciated, no truth, law or permanent record can be established.

Unfortunately, it is the custom to give undue prominence to cost without equating the value received for such costs. A pavement has many desirable qualities other than durability or low first cost. These qualities have a value which is often difficult to express in terms of money.

The need of an adequate and reliable standard for comparing pavements is imperative.

### WHAT A PAVEMENT IS.

A pavement is a structure designed to serve the traffic using it, in a satisfactory and *efficient* manner.

Bearing in mind that a pavement is an engineering construction, it is possible to determine the laws applicable to the design of its component parts. A pavement consists of at least two of the following parts:

1. Sub-grade, or Natural Foundation.
2. The Structural Foundation.
3. The Wearing Surface.

In the case of block pavements and standard asphalt pavement, a sub-foundation, called a "cushion," "binder" or "bedding course" is invariably used. Frequently a foundation or a wearing surface is treated with a temporary "protective coating."

For different soil and climatic conditions there are certain rules to be followed in securing a compact earth sub-grade. To maintain this natural foundation, provision must be made for adequate drainage to remove both surface and sub-soil water. Some localities, notably Massachusetts and California, have solved the sub-grade problem as it affects their work in a fairly satisfactory manner. No matter what type of pavement is used the sub-grade should be properly *constructed.*

The structural foundation should be rationally designed depending upon the loads that may be imposed upon the sub-grade, the strength of the material comprising the foundation, and the loads to be transmitted by it from the moving traffic above to the sub-grade below. There are but two foundations in practical use, namely, macadam, including telford, and concrete. In city pavements, under the prevailing uncertain conditions, involving excessive traffic and loading, and frequent openings for repair of underground utilities, it is more rational to specify a concrete foundation than any other kind. In view of the fact that the low price of cement and recent development of economical methods of handling and placing concrete has rendered a concrete foundation actually cheaper than a macadam or other uncertain material, of *equivalent structural strength,* it should be incumbent on all engineers to specify a concrete foundation to the exclusion of all other forms. Granting this, it only remains to determine proper thickness, quality of concrete, and, if abnormal conditions obtain, the location and amount of re-inforcement to be used.

The principal function of the wearing surface is to resist both wear and the destructive action of the weather, and provide a safe and convenient surface for the traffic. There is a tendency towards the construction of monolithic pavements, or making the wearing surface and foundation a unit structurally. This is evident in the familiar concrete pavement, one course, two course, or reinforced, and very recently in hard block (brick or granite) pavements. These hard block pavements are laid on a cement "cushion" and the joints grouted with cement mortar directly following the laying of the concrete base, causing the entire structure to "set up" as a solid mass. While this method works for structural efficiency, it must be remembered that other considerations, as effect of temperature, noiselessness, repairs of openings, good foot-hold and "wheel-hold," cost, and workmanship must be given their proper weight. Monolithic pavements should prove acceptable in traffic yards, alleys, and streets of light traffic; or where power vehicles are used exclusively. Experience and engineering wisdom indicate that the so-called "cushion" where used should be a stable substance that will furnish a permanent uniform bearing for the block directly onto the fairly even surface of the concrete base. A cement mortar "bedding course" spread dry and moistened prior to filling the joints should be specified as a proper "cushion" for all block surfaces, regardless of the filler used.

There are but six recognized types of pavement surfaces adapted to city streets. These may be arranged in the order of their intrinsic durability, as follows: Granite (Stone) Block, Brick, Creosoted Wood, Standard Asphalt, Asphaltic Concrete, and Concrete of standard composition and thickness. Macadam, either water-bound or bituminated, and plain concrete, while suitable on outlying roads or unfrequented streets, when properly and continuously maintained, must be eliminated as satisfactory paving materials or surfaces where the multiple considerations that govern in the modern city are honestly faced. These considerations are durability, ease of repairs, infrequency of maintenance, ease of cleaning, low tractive resistance, non-slipperiness, favorableness to travel, sanitary qualities, noiseless and general acceptability. First cost, while important on country roads, should be regarded as a subordinate factor in the selection of city pavements. Public use, convenience, and safety are paramount to cost in the modern city.

### TRAFFIC.

In order to design a pavement *efficiently,* or to estimate the service of an existing one, the character of the traffic must be known or closely assumed.

A traffic *investigation* should be made. This is more comprehensive than a detailed census, and is a strictly engineering proposition. The amount of traffic must be determined and this divided into the different kinds of vehicles, with their sizes, weights, kind and width of tires, rate of travel and handling. It is evident that, structurally, the pavement must be designed to withstand the maximum load and use that may come upon it, with a safety factor commensurate with the economic service expected of the type selected.

The cost of service in any pavement structure, subject to use, is determined by the factors of first cost, cost of maintenance, interest on first cost and sum to be realized to replace the surface when worn out. In comparing pavements different standards exist, but none of these are in universal use. In estimating the life of a pavement, the economic factors are usually considered and the time estimated or discovered when it is cheaper to replace the pavement than to continue to repair it. The service test is frequently reduced to tons per foot or yard width of roadway, per day, per year, or for the assumed life. There are two types of vehicle traffic, namely, *Rolling Traffic,* consisting of horse-drawn vehicles, auto trailers, and road rollers, and *Shearing Traffic,* consisting of automobiles, auto trucks, power busses, and tractors with cleats on wheels.

The necessity of limiting speeds, especially as regards shearing traffic, is due to public safety, and because of the effect of weight and impact on wearing surfaces and pavement foundations. The effect of impact and shearing stress on the inferior surfaces, such as macadam and light bitumen surfaced pavements, must eliminate them from consideration as acceptable constructions for use in cities not observing proper traffic regulations. Until allowable weights or other regulatory restrictions are enforced on the modern auto traffic, particularly trucks, the engineer must design pavements on all traffic streets with an adequate concrete foundation and an efficient wearing surface.

It has been observed in Chicago that a five-inch concrete foundation of 1-3-6 mixture laid on an undrained sub-grade will, when less than ten days old, shear under the wheels of a fifteen-ton auto truck running about ten miles per hour.

In order to design structures efficiently, we must evolve values for the factors entering into the determination of the proper construction for the given conditions of use. The meager data secured by random observation should be re-inforced by tests conducted at our various experimental stations. Various mixtures of concrete of different thickness should be laid on different soils and subjected to various loads at known speeds, and the results properly established. Many experi-

mental roads have been laid, but it is rare to find all the features of construction properly tabulated and explained.

With regard to wearing surfaces there are many elements to consider. Where the pavement is laid as a monolith, the surface is structurally a part of the foundation and is therefore hard and unyielding. Where horse-drawn traffic is used a so-called "soft" or slightly yielding surface is most acceptable.

With power vehicles, equipped with springs and elastic tires, a hard rigid surface, slightly rough to prevent skidding, is most desired. The difficulty comes in adapting a pavement and surface to satisfy a mixed type of traffic.

The problem of maintenance and repairs is a vital one in the busy city. To the actual cost of the work must be added the inconvenience and discomfort caused by interruption to the traffic.

Based on observation and confirmed by the general practice and tendencies of American cities, the following table has been prepared to indicate the adaptability of various types of pavements for different kinds of traffic.

The foregoing table is comparative and is, of course, based on experience or recommended practice, and not a scientific compilation. The science of rational pavement design is still in its infancy, yet this does not deter us from employing conservative knowledge and from this, as a basis, working out in time a reliable, if not an exact, method of solving the paving problems of our cities. The elements to consider in selecting the proper pavement for a given street subject to certain conditions are many and varied. Adaptability for traffic is but one of the complicated elements to be satisfied.

"Standard" specifications, so-called, are good to a limited extent. Their limitations must be determined in the light of knowledge of local conditions. Local conditions comprise: climate, drainage, available material, traffic, and quality of workmanship and supervision.

The type of construction to be used should be determined by the engineer or expert and the reasons therefor advanced that the public may have a proper appreciation of the true engineering character of the problem. Until the public and their representative officials realize that the solution of pavement construction is an engineering proposition, very similar to a sewer or water system, little progress can be expected in placing pavement design and construction on a scientific plane.

TABLE.

| Kind of Pavement (Wearing Surface) | Kind of Cushion | Kind of Foundation or Base | Kind of Filler in Joints | Est. Life in Years | Note "A" Type of Streets where Used or Suitable | Note "B" Kind of Traffic Pavement is Suitable for |
|---|---|---|---|---|---|---|
| 5-inch Granite Blk. | 2" sand | 8" concrete | Tar | 30 | 1, 5, 7 | U-W-X |
| "Modern" Granite Blk. | 1" mortar | 6" concrete | Cement | (25) | 1, 3, 5, 9 | V-W-X-Z |
| Creo. Wood Block | ½" mortar | 6" concrete | Tar or Asphalt | 10-20 | 3, 5, 4-9 | U-X-Z |
| Brick | 2" sand | 6" concrete | Asphalt | 20 | 5, 7, 9-11-6 | V-X-Z-(U) |
| "Modern" Brick | 1" mortar | 6" concrete | Cement | 25 | 5-7-11-6-8-10 | V-X-Y-Z |
| Monolithic 3" Brick | ½" mortar | 4" concrete | Cement | (20) | (7)-11-8-10 | X-Y-Z |
| | Depth of Surface | | | | | |
| Asphalt | 2" top 1½" binder | 6" concrete | - - - - - | 20 | 2-4-6-3 | V-X-Y-Z |
| Asphalt | 1½" top 1" binder | 5" to 6" concrete | - - - - - | 15 | 11-4-6-(10) | X-Y-Z |
| Asph. Concr. | 2" top | 6" concrete | - - - - - | 12 | 11-4-6-2 | X-Y-Z |
| Concrete | Reinforced | 7" average | With tar Sand coat'g | (10) | 11-8-10-12 | V-Y |
| Bit. Mac. | 2½" top | 8" stone | Asphalt or tar | (8) | 11-10-12 | X-Y |
| Water Bound Macadam | 2" top | 10" stone | Water and screenings | (5-10) | (10) | X |

Note—Figures in parenthesis are questionable.

Note "A"—Types of Streets usually present in cities may be classified and designated as follows:

BUSINESS STREETS

| Common Classification | Symbol |
|---|---|
| Heavy R.R., Dock, Warehouse, and Factory District | 1 |
| Retail Down Town Streets | 3 |
| Car Line or Radial Business Streets | 5 |
| Local Traffic Business Streets | 7 |
| Alleys in Business District | 9 |
| Outlying Roads | 11 |

RESIDENCE STREETS

| Common Classification | Symbol |
|---|---|
| Boulevards (Pleasure Drives) | 2 |
| High Class Residence Streets | 4 |
| Medium Class Residence Streets | 6 |
| Alleys in Residence District | 8 |
| Short or Local Traffic Streets | 10 |
| Private Roads and Park Drives | 12 |

Note "B." Kinds of traffic usually present in cities may be classified and designated as follows:

Heavy (weight) slow moving Rolling Type.....U
Heavy (weight) fast moving Shearing Type.....V
Large Number Heavy fast moving Mixed Type.....W
Light (weight) slow moving Rolling Type.....X
Light (weight) fast moving Shearing Type.....Y
Large Number Light fast moving Mixed Type.....Z

* * *

## More Changes in the Pennsylvania State Highway Department

Several additional changes in the engineering force of the Pennsylvania State Highway Department were announced the early part of March, all of which became effective at once. These changes were all in the nature of promotions, and were all made under the merit system, which is strictly in force in that department since Mr. Cunningham became State Highway Commissioner and Mr. Uhler became Chief Engineer. The changes referred to were all in the Engineering Division and the Bureau of Township Highways.

In the Engineering Division, P. M. Tebbs, for several years assistant engineer in charge of District No. 12, with headquarters at Scranton, has been promoted to Engineer of Construction, with headquarters in the Highway Department at Harrisburg. Mr. Tebbs fills the vacancy caused by the recent resignation of John T. Gephart, Jr., who is now county engineer of Fayette County, with headquarters at Uniontown, Pa.

W. A. VanDuzer, who has been assistant engineer in charge of District No. 6, with headquarters at York, has been transferred to Scranton in charge of District No. 12, succeeding Mr. Tebbs.

The vacancy thus created in District No. 6 has been filled by the appointment of Charles W. Erisman, draftsman in the

Bureau of Township Highways, who is now acting assistant engineer of the district, with headquarters at Scranton.

In the Bureau of Township Highways, the State of Pennsylvania has been divided into five districts, and promotions have been made from the ranks to secure the five men who will act as assistant engineers in charge of these five districts. The object of this change is to facilitate the work of the Bureau of Township Highways, which is under the direction of Joseph W. Hunter, First Deputy Highway Commissioner, and to bring it and the State Highway Department into closer touch with the township supervisors and the general public.

In the Bureau of Township Highways, under this new arrangement, the districts, with the engineers in charge will be as follows:

*First District.*—The headquarters will be at Harrisburg, and will be composed of the following counties: Dauphin, Lebanon, Schuylkill, Berks, Lancaster, Lehigh, Northampton, Bucks, Montgomery, Chester, and Delaware. The name of the assistant engineer who will be in charge of this district is withheld for the present.

*Second District.*—The headquarters of this district will also be at Harrisburg, and includes the following counties: Cambria, Somerset, Blair, Bedford, Huntingdon, Fulton, Franklin, Adams, York, Mifflin, Juniata, Perry, and Cumberland. Mr. George L. Sollenberger, formerly of the Bridge Division, has been promoted and will be in charge of this district.

*Third District.*—Pittsburgh will be the headquarters of this district, and the following counties will be included: Lawrence, Butler, Armstrong, Indiana, Beaver, Allegheny, Westmoreland, Washington, Greene, and Fayette. The district will be in charge of R. B. Hamill, formerly a chief of party in the Bureau of Township Highways at Harrisburg.

*Fourth District.*—The headquarters of the district will be at Warren, and the following counties will be included: Erie, Crawford, Mercer, Venango, Clarion, Forest, McKean, Elk, Jefferson, Clearfield, Cameron, Potter, Clinton, and Centre. W. F. Miller, promoted from the Bridge Department, will be the district engineer in charge.

*Fifth District.*—The headquarters of the Fifth District will be at Bloomsburg, and will comprise the following counties: Tioga, Bradford, Susquehanna, Lycoming, Sullivan, Wyoming, Lackawanna, Luzerne, Columbia, Montour, Northumberland, Union, Snyder, Wayne, Pike, Monroe, and Carbon. Harry G. Harper, formerly attached to the Harrisburg office, has been appointed the assistant engineer in charge of the district.

The formation of these five districts of the Bureau of Township Highways, and the promotions named of the Assistant Engineers in charge became effective on April 1, all plans and details having been carefully worked out by First Deputy Commissioner Joseph W. Hunter.

One of the principal reasons for the creation of these five districts, and one of the main things to be gained by this important change in the Bureau of Township Highways in placing these districts under its jurisdiction, will be that surveys for improvements contemplated by the township supervisors in the future can quickly and economically be made by the engineer in charge of the district in which the work is proposed, without having to wait for an engineer to be sent out to do this work from the Harrisburg Office, as has been necessary and the custom in the past. The engineers appointed to take charge of these five districts will act directly under the supervision of the Bureau of Township Highways, so that there will be no confliction with the assistant engineers in charge of the districts as divided and under the direction of the Engineering Division.

Charles W. Erisman, who has been appointed assistant engineer in charge of District No. 6 of the Engineering Division, was born at Lancaster, Pennsylvania, October 31, 1886. He was educated in the public schools and in the high school at Lancaster, and at the age of eighteen entered the employ of F. H. Shaw, of Lancaster, who was engaged in sewage and filtration plant construction. In September, 1906, Mr. Erisman, entered the construction department of the Pennsylvania Railroad Company, where his first work was on the relocation of the Columbia and Port Deposit Branch of that railroad from Safe Harbor to Benton, Lancaster County. He entered the Pennsylvania State Highway Department as a draftsman on March 1, 1907, and has been with the department continuously since that date, having filled the positions of chainman, rodman, levelman, transitman, chief of party, draftsman, inspector, and assistant engineer in the Bureau of Township Highways.

* * *

## North Carolina

*Beaufort County.*—On January 4, Washington Township voted a $50,000 bond issue for good roads. There is a movement on foot to combine Washington, Long Acre, and Chocowinity townships into a united road district, with a bond issue of $100,000.

*Brunswick County.*—The road from Southport to Wilmington, up the Cape Fear River, is now in course of construction. It has been opened five miles from Southport, and will connect with the roads in Town Creek Township, when the bridge over Waldon Creek—four miles out—is constructed. This will be in the next month or two. When completed this road ought to be very popular, especially for the pleasure-seekers. It will be in sight of the Cape Fear River almost the entire distance from Southport to Wilmington. This road will be of sand-clay construction.

*Forsyth County.*—The County Highway Commission of Forsyth County has been very active this winter in the construction of highways in the county. There has been very little time lost on account of weather conditions. From about the first of December several miles of road have been graded, all three forces having been kept busy. County Engineer Harmon reports that the work on the Yadkin road is progressing very satisfactorily, good work having been done during January and February. About four miles of the Tobaccoville road has been completed. This road has not heretofore been known or used by the people as much as it should have been, but leading as it does into a territory where there had been no road improvements, it has now become one of the most important of soil roads, and is of a fine type of construction. The two miles link on the road leading to High Point, makes a fine connection between the two cities, and was badly needed. Four miles of soil road toward Pine Hall, opening a direct route to Madison and Roanoke, have been constructed to the county line. This is considered the most interesting scenic stretch of highway in the county. It leads off from the old chair factory site at Walkertown to Pine Hall. The construction of the Germantown road from the Rural Hall Road to the Stokes County line is another piece of road that has long been dreamed of, and is now accomplished. With the building of this stretch of four and a half miles a direct route is established into the very heart of Stokes County, and is essential to the development of Forsyth, as well as an aid to Stokes County. Another important road is in the Red Bank Road, which penetrates the Box Mountain section for a distance of two and one-half miles, anl gives a fine soil road to a section of the county that has heretofore not been reached by improved roads. In the southern part of the county, and leading from the Salisbury road, a two-mile stretch toward Lexington, known as the Mock road, is another important link constructed, and this opens up a section that has not heretofore been reached. Between Dennis and Fulp on the road to Walnut Cove, two miles of road have been completed during the past year, the building of which has long been delayed. The commission has also completed the Tri-county Post Road via Clemmons, leading to the Forsyth-Davis bridge, with the co-operation of the Federal Government. This included the reconstruction of about two miles near Hanes Station and the construction of Tarvia type of road from Peters Creek, west of the city, to the top of Hanes Hill. The road from Brookstown to the Forsyth-Yadkin bridge, a distance of about four miles, is graded practically the entire distance, and this road has also been partly soiled. It will be completed at once and will open up a route connecting with Yadkin roads just being constructed. The Belews Creek Township, another important road, has been started, one mile of which has been so far constructed. This is the first improvement in Belews Creek Township, except a short stretch across one corner, which has been of comparatively little service to the people of that section. This new road leads into one of the best sections of Forsyth, which has in the past been more closely allied with Guilford County and Greensboro because of the inaccessibility of the remaining section of Forsyth.

Several short soil sections have been constructed, including Sunnyside Avenue, about half a mile in length; the road from Peters Creek to Ardmore, and the road leading into Old Town, in all, about two miles. Work has also been started on the concrete road on the Salem Hill, and the road leading from Broad Street terminus to the Salisbury Road. This last link will open up a section of the county that has heretofore been shut off from any direct communication with the city, being compelled to take a circuitous route to reach the city at all. This is conceded to be the most constructive piece of road ever proposed in the county, and will prove a great benefit to the people.

*Gaston County.*—Gaston County recently voted a $150,000 bond issue; $50,000 of which is to be spent on new roads. The following new roads will be constructed: A sand-clay road from the town of Cherryville to the Cleveland county line, on the Waco Road. This is to be constructed by the chain gang. There will be built a sand-clay road from the Spencer Mountain Bridge, by way of Stanley to the creek at the Dick Rhyne place in River Bend Township. This road is also to be built by the chain gang, and in connection with it a sand-clay road from the Macadam road at Arthur Rhyne's to the bridge at McAdenville will be built.

*Caldwell County.*—Lovelady Township, Caldwell County, has completed, since January, about one and one-half miles of improved roads. The grade work was not heavy, and the top-soil convenient to the road. They have under construction in Caldwell a bridge over the dam of the Granite Falls Cotton Mill Company. This will be built of reinforced concrete at a cost of $3,700. Contract has been awarded the company putting up the dam. Steel has also been ordered for another bridge over the same stream, and for two smaller bridges in Lovelady Township.

*Cabarrus County.*—The work of resurfacing the macadam highway between Concord and Kannapolis, a distance of more than six miles, is progressing very nicely, under the direction of Mr. J. M. Burrage, who is assisting the County Superintendent of Roads, Mr. Widenhouse, in this job. The county purchased a heavy "scarifier" for the purpose of ripping up the surface of the worn macadam on this road, so as to make a good bonding of the new topping or surfacing of crushed granite, which is being applied. After this is finished, there is to be applied a Tarvia or bituminous binder. This road is a link in the New York-Atlanta National Highway, and has a very heavy travel passing over it. When finished, it will be a fine roadway. Considerable work has been done during the past month upon the various county roads throughout the different townships. The use of the road drag is becoming more general in this county, and the benefits derived from its use are so pronounced as to remove all doubts as to its efficiency. This county is also doing some good work in putting sand and gravel or top-soil of suitable kind on some of the weak stretches of some of their sand-clay roads. They are expecting to build several miles of sand-clay road this year, and to straighten and reduce the grade on some of the hilly places, and improve their dirt roads in every way possible, so as to maintain them in the best possible condition by the timely use of the split-log drag, or plank type of drag, used after each wet spell or heavy rain. Greater interest is being manifested in road work generally by the citizens of this county.

*Wake County.*—This county has four main camps of about twenty-three prisoners and twelve mules each. They are building gravel roads out of Raleigh. One of these camps is on the Wake Forest Road, one on the Milburnie Road, and one on the Fayetteville road, and one on the Hillsboro Road.

In addition to these Wake County has four floating or repair camps of about ten mules and sixteen prisoners each. One of these camps is located in Rolesville and another at New Hill. These camps do a good line of repair work, such as widening, straightening, and graveling the worst places. And while this work is not permanent, except the location and drains, it will not be wasted when the road is permanently built at any future time. This county has a very good patrol system. There are four patrol forces of four to six men and six to eight mules each under the patrolman. These men have their own kitchen and sleeping quarters on wheels ready to hitch to and move at a moment's notice. In addition to this they have a wagon force of one team, wagon, scoops, drags, etc., which is very useful.

* * *

## Cleanliness and Health Follow Extensive Use of Concrete

"This is certainly a clean place," was the comment of each of the thirty-eight delegates from the Iowa League of Municipalities who visited the "Model Town" adjoining the new plant of the Universal Portland Cement Company, at Duluth. And the first remark of every visitor is practically the same.

The town was built to accommodate the employees of the Universal Portland Cement Company and the Minnesota Steel Company at the new plant at the head of the Great Lakes. The cement plant is now in operation and will be able to turn out four thousand barrels of Universal Portland Cement per day, serving Minnesota, the Dakotas, Montana, Wisconsin, and the upper peninsula of Michigan.

Sixty thousand square yards of street pavement as well as all alleys, curbing, sidewalks, lawn walks, steps, and nearly five hundred detached houses and two to six unit apartments, built solely of concrete, constitute the features of this place, called Morgan Park, a village in Duluth.

Concrete on the business street is laid in two 18-foot strips on either side of a parkway designed to later accommodate a street railway line. On residence streets, the pavements are twenty-two feet in width. While custom dictates a somewhat wider pavement, yet expeirence shows that one vehicle may pass easily and safely between two vehicles standing opposite each other at the curbs on a 22-foot pavement.

Narrow widths of street pavements permit improving a greater mileage than where the streets are wide. Naturally the type of residence street must be considered. If the section abounds in tall apartment buildings where traffic is comparatively heavy, a wider pavement should be built than in sections composed principally of detached homes. In addition, tall buildings shut out the light, and therefore, demand wider streets. While future growth may change a small residence section to one of tall apartments, yet the question of light and air may be cared for and though narrow pavements may be built, by making the total width between property lines the same as in densely populated residence districts. This gives a wide parking between curb and sidewalk and enhances the attractiveness of the district.

The designers of Morgan Park were among the first to recognize the value of one-course concrete for curbs and sidewalks, and this practice has been followed throughout. Instead of the usual lean first course and comparatively rich top coat, the concrete consists of a single course of carefully mixed ingredients in which the large aggregate, by virtue of being exposed, bears the brunt of surface wear. This was accomplished in curbs and steps by removing the forms before the concrete had its permanent set, when the surface was brushed to remove form marks as well as to expose the coarse aggregate. A careful selection of aggregates obtained variation in color.

Concrete has also been used to solve the alley problem. While the width of these pavements is only eight feet, yet the three oval turnouts in each block provide ample opportunity for vehicles to pass each other.

The extensive use of concrete for municipal purposes, as well as for all the dwellings, gives the village a clean, attractive appearance. Residents take pride in keeping their yards in harmony with the clean, light-colored concrete surrounding them. Alleys are free from filth and displeasing odors. Each rain washes off sidewalks, streets, and alleys, and the hard, tough pavement surface eliminates all dust. Good health accommpanies such cleanliness.

The Morgan Park work was done under the general direction of Owen Brainerd, Consulting Engineer, of New York City. Morell and Nichols, Landscape Architects and Engineers, Minneapolis, were in charge of the municipal work, and Dean and Dean, Chicago, were architects for the buildings.

## Excess Water vs. Enough

Every road builder knows, or should know, that bank-run gravel is unsuitable for roal work, that dirty aggregates should not be used, and that an excess of water in the mix is harmful. But for any who might have been skeptical about one or all of these points, the tests made at the Joint Exhibit of Cement Manufacturers during the recent Cement Show, furnished abundant proof.

Under the direction of Prof. D. A. Abrams, a large number of 6 by 12 inch concrete cylinders were cast at the Structural Materials Research Laboratory of Lewis Institute, Chicago, prior to the show, and tested on a 200,000-pound Olson hydraulic testing machine during the show, by experienced engineers in the presence of many contractors, engineers, and other visitors.

Little need be said regarding the comparative results of the tests on graded vs. bank-run materials and on clean vs. dirty aggregates. Nowadays practically all concrete road specifications forbid the use of bank-run, and specify a certain maximum amount of clay and loam allowable in the aggregates, this allowable amount being very small.

It is sufficient, therefore, to summarize the results as follows:

Graded vs. bank-run.

Average compressive strength at (about) 30 days:

1:2:4 mix .....75,500 lbs.
1:6 bank run .....57,020 lbs.

Highest and lowest values recorded (indicating the variation):

1:2:4 mix ...60,000 lbs. 93,500 lbs. 55% variation
1:6 bank-run 39,000 lbs. 73,000 lbs. 87% variation

Clean vs. dirty.

Average compressive strength at (about) 30 days:

Clean .....77,920 lbs.
Dirty .....62,700 lbs.

Highest and lowest values recorded (indicating the variation):

Clean .....57,000 lbs. 98,000 lbs. 72% variation
Dirty ..... 6,000 lbs. 78,000 lbs. 1200% variation

Attention should be called to the "variation" figures which indicate, respectively, that bank-run and dirty materials produce more *unreliable* as well as weaker concrete than well graded and clean materials.

Herewith are given complete tables showing (Table I.) the quantities of materials and water used in making the specimens for the "Excess water vs. Enough" tests, and (Table II.) the results of the tests.

TABLE II.

*Results of Tests of Concrete Cylinders*

Excess Water vs. Enough

| Age in Days | Enough | Excess |
|---|---|---|
| 28 | 74,000 lbs. | 35,000 lbs. |
| 28 | 72,000 lbs. | 50,000 lbs. |
| 30 | 72,000 lbs. | 52,000 lbs. |
| 30 | 71,000 lbs. | 41,000 lb |
| 31 | 95,000 lbs. | 49,000 lbs. |
| 28 | 70,000 lbs. | 40,000 lbs. |
| 32 | 83,000 lbs. | 40,000 lbs. |
| 31 | 86,000 lbs. | 53,500 lbs. |
| 30 | 97,000 lbs. | 45,000 lbs. |
| 28 | 75,000 lbs. | 70,000 lbs. |
| 31 | 93,500 lbs. | 50,000 lbs. |
| 32 | 77,000 lbs. | 70,000 lbs. |
| 29 | 77,000 lbs. | 72,000 lbs. |
| 29 | 74,000 lbs. | 70,000 lbs. |
| Average | 79,030 lbs. | 52,680 lbs. |

These figures speak for themselves. Now to apply them to concrete road work.

Concrete roads crack; cracking is the feature most objected to in concrete roads; and it is coming to be the belief of practically all highway engineers that, given good foundation and drainage, the most productive cause of cracking is the use of too much water in the mix.

On probably more than seventy-five per cent. of all concrete road work the materials are mixed too wet. The question, therefore, is one which cannot be given too great consideration.

The report of the Committee on Resolutions of the Second National Conference on Concrete Road Building, which is printed elsewhere in this issue, says:

"Consistency. The practice is to mix concrete entirely too wet. The consistency should be such as not to require tamping, but not so wet as to cause the separation of the mortar from the aggregate in handling and placing. *The strength and wearing qualities of the concrete are vitally lessened by an excess of water in mixing.*"

In the results of the tests given above, the average strength of concrete of normal consistency is shown, at thirty days, to be more than fifty per cent. greater than that in which an excess of water was used. It does not take much imagination to figure out why a concrete pavement slab, mixed too wet, will pull apart (crack), when one mixed with a normal consistency will have strength enough to resist cracking to a far greater degree.

TABLE I.

Structural Materials Research Laboratory,
Lewis Institute, Chicago.

CONCRETE TEST SPECIMENS MADE FOR 1916 CEMENT SHOW

*Excess Water vs. Enough*

| | Excess—1:2:4 Mix<br>Materials used for one cylinder<br>Cement, 4.7 lb.<br>Sand, 10.8 lb.<br>Gravel, 20.7 lb. | | | | Enough—1:2:4 Mix<br>Materials used for one cylinder<br>Cement, 4.7 lb.<br>Sand, 10.8 lb.<br>Gravel, 20.7 lb. | | |
|---|---|---|---|---|---|---|---|
| Mark | Date Made 1916 | Water Amt. cc. | Water Per cent. | Mark | Date Made 1916 | Water Amt. cc. | Water Per cent. |
| E1* | 1/15 | 1475 | 8.98 | F1* | 1/15 | 1100 | 6.72 |
| E2 | " | " | " | F2 | " | " | " |
| E3 | " | " | " | F3 | " | " | " |
| E4 | " | 1500 | 9.14 | F4 | " | " | " |
| E5 | " | " | " | F5 | " | " | " |
| E6* | 1/18 | 1500 | 9.14 | F6* | 1/18 | 1100 | 6.72 |
| E7 | " | " | " | F7 | " | " | " |
| E8 | " | " | " | F8 | " | " | " |
| E9 | " | " | " | F9 | " | " | " |
| E10 | " | " | " | F10 | " | " | " |
| E11 | 1/20 | 1500 | 9.14 | F11 | 1/20 | 1125 | 6.85 |
| E12 | " | " | " | F12 | " | " | " |
| E13 | " | " | " | F13 | " | " | " |
| E14 | " | " | " | F14 | " | " | " |
| E15 | " | " | " | F15 | " | " | " |

*Tested at age of 14 days.

The relation between consistency and strength was similarly proven by Committee VIII. of the Second National Conference on Concrete Road Building, whose members also tested a large number of cylinders. This committee was composed of Chairman Ernest McCullough, Consulting Engineer, Chicago; John Wilson, Consulting Engineer, Duluth; Ernest Ashton, Chemical



**The 200,000 Pound Olsen Hydraulic Testing Machine testing 6 x 12 inch concrete cylinders in the Joint Exhibit at the Cement Show.**

Engineer, Lehigh Portland Cement Company, Allentown, Pa.; G. E. Scott, Contracting Engineer, Norwalk, Ohio, and A. D. Williams, Chief Engineer, West Virginia State Road Bureau, Morgantown, W. Va.

The following is quoted, with a little rearrangement, from Appendix B of the committee report.

APPENDIX B.

Structural Materials Research Laboratory, Lewis Institute, Chicago.

Compression Tests of Concrete (Final Report).

1:2:3 machine mixed concrete.

6 by 12 inch cylinders.

Age at test, 1 and 2 months.

The specimens tested at one month were stored in damp sand during the first three weeks; in air for the remainder of period; the two-month specimens were stored in damp sand except for about one week during shipment, at age of three weeks, and twenty-four to thirty-six hours previous to test.

The specimens were made at the plant of the T. L. Smith Company, Milwaukee, Wisconsin, on Friday, . . . November 12, . . . 1915, under the auspices of the Committee on Mixing Concrete of the Second National Conference on Concrete Road Building, Mr. Ernest McCullough, Chairman.

The concrete was mixed in a Smith-Chicago Paver, high drum type, No. 507, running fourteen revolutions per minute. The batches consisted of one bag of Portland Cement, two cubic feet of sand, and three cubic feet of gravel. Each batch was given a mix of one full minute from the time the skip was dumped into the drum to the beginning of the discharge of the mixed materials. . . .

Materials used: Universal Portland cement, sand and gravel same as that used in Milwaukee County road work. The water was measured by an automatic measuring device, patented by the T. L. Smith Company. Regulation of amount of water for each batch was effected by moving a catch to engage in notches on a projecting arm.

Complete series of tests on cement and aggregates was carried out by the Structural Materials Research Laboratory. Tests were also made on concrete from the same materials mixed by hand under laboratory conditions.

The information concerning the materials, manufacture of specimens, etc., was furnished by Ernest McCullough, Chicago.

January 14, 1916.

| Mark | Comp. Strength lb. per sq. in. 1 mo. | 2 mo. | Remarks |
|---|---|---|---|
| B1 | 3700* | 5140 | 20° slope of chute. Stiff, pasty concrete. Ideal for general work; not for road work. 4.6 lb. (.074 cu ft.) of water per cu ft. of materials. |
| | 4420 | 5740 | |
| | 4150* | 4020* | |
| Average | 4090 | 4970 | |
| A2 | 2970 | 4970 | 25° slope of chute. Consistency pronounced ideal for road work. 5.3 lb. (.085 cu. ft.) of water per cu. ft. of materials. |
| | 3320 | 5300 | |
| | 3840* | 4480 | |
| Average | 3380 | 4920 | |
| B2 | 4410 | 4880* | 20° slope of chute. Consistency ideal for road work. 5.3 lb. (.085 cu. ft.) of water per cu. ft. of materials. |
| | 4100 | 5250 | |
| | 3840* | 5350 | |
| Average | 4120 | 5160 | |
| B3 | 2740 | 3690 | 20° slope of chute. Consistency often used but considered too wet for road or reinforced concrete work. 6.5 lb. (.104 cu. ft.) of water per cu. ft. of materials. |
| | 2940 | 4050 | |
| | 3070 | 3710 | |
| Average | 2920 | 3820 | |
| C3 | 3160 | 4240 | 20° slope of chute. Consistency same as B3. 6.5 lb. (.104 cu. ft.) of water per cu. ft. of materials. |
| | 3340 | 4170 | |
| | 3330 | 3570* | |
| Average | 3280 | 3990 | |
| B4 | 2770 | 3330 | 20° slope of chute. Consistency sloppy mix. 7.6 lb. (.122 cu. ft.) of water per cu. ft. of materials. |
| | 2690 | 3450 | |
| | 2720 | 3560 | |
| Average | 2730 | 3450 | |

*Concrete was not well compacted in form.

Based on the results of these tests, recommendations of the committee included the following paragraph:

"A most important item is the amount of water to use. The mixture should flow readily in order that it may be properly spread and consolidated, yet in attempting to obtain this end it is easily possible to use more water than is desirable. As the result of experiments made in Milwaukee . . . your committee believes that, with the average amount of moisture found in concrete materials, the water to be used in a proper mix for concrete used in road-making should not exceed six (6) pounds (.096 cu. ft.) per cubic foot of materials —this meaning the cement, sand, and stone measured loose. *The most needed reform in the mixing and placing of concrete for our roads is less water than is generally used.*"

* * *

## The Annual Good Roads Show

THERE was held in connection with the Thirteenth Annual Convention of the American Road Builders' Association, the seventh show that has been held by the Association, the first exhibition having been held at the meeting in Columbus, Ohio, in 1909. The 1916 show was held in the Machinery Hall, and nearly all the space was taken. Many of the leading concerns manufacturing road machinery and road materials were conspicuous by their absence, however, having decided to stand pat on their decision to not exhibit at any so-called National Road Congress or Road Show until arrangements had been made whereby there would be one National Road Congress and Exhibition. These concerns did not, and in fact most of the exhibitors who had space at Pittsburgh did not recognize the Pittsburgh show as the one National show. They had not, no more than has Better Roads and Streets, any crow to pick with the American Road Builders' Association, but the decision has been reached that there must be but one National show, and future developments will show whether it will be conducted by the American Road Builders' Association or by some one else. This is considered immaterial by exhibitors or by Better Roads and Streets, as full co-operation and support will be given the *real National show*, held *annually*, regardless of whom it is held by.

All the well-known concerns which did not exhibit had full representation at the meeting, however, and many of these expressed their joy at the fact that they did not have to be troubled with the troubles that we all have when we are tied up at a booth for days at a time. They were free—for once—they said, and would remain free in this same manner until it is decided how the *national show* is going to be held. They all like to attend a convention and show occasionally, was the unanimous agreement, but they are still, and always will be,

sick and tired of attending a *so-called National Road Congress* every month or two, throwing them back in their work, disorganizing their forces and costing them large sums of money from which there cannot be any material return.

The exhibits at Pittsburgh were good. The attendance was also good. Much of the equipment that was shown on the floor was sold by the exhibitors before the close of the show. There was an unusually large number of machinery, material, and equipment men among the visitors to the exhibits. In fact, the writer cannot recall ever having seen so many before at a road show. Many of these claimed that the balance of the attendance did not begin to justify the large number of material and equipment men present, it having been conservatively estimated that there were one-third as many material and equipment men present as there were contractors, road engineers, supervisors, superintendents, commissioners, and others who have actually any buying power. This is another feature that would be eliminated if there can be held *one National Road Congress annually.*

We were present at the frost and failure held at Oakland, California, last September. We were likewise present at Pittsburgh. The Pittsburgh convention and show were not a frost or failure. In fact, we are frank to say that both were successes. And it simply bears out our contention that, if arrangements are made, and they will undoubtedly be made this fall, for the holding of a *Real National Road Congress and Exhibition,* such a venture will be a howling success. The American Road Builders' Association held its convention this year at the proper time for holding such a convention. Exhibitors were unanimous in agreeing on this point.

The concerns which did exhibit at Pittsburgh were, generally speaking, well satisfied with results. This was particularly true of the machinery concerns which had the actual machinery at the show. Several of them told the writer that they had nothing but literature, prospect cards, and expense accounts to send back to their factories, as all equipment on the floor had been disposed of locally. Some of the road material concerns were not so well pleased, however, as they claimed that they had not done so well, other than to greet old friends and keep their product before the public and machinery and material men in large numbers.

## THE EXHIBITORS AND THEIR EXHIBITS.

The exhibits at the Pittsburgh Show were, as usual, quite varied, and included much that was of general interest to the delegates and visitors. Owing to the large number, but brief mention can be made of them, this being necessitated by lack of space in Better Roads and Streets.

The city of Pittsburgh had the largest space, and provided a most interesting exhibit. It was devoted largely to data and statistics on what the city has done in paving and street cleaning, and in the removal of the "Hump," which necessitated a large amount of grading and repaving, involving the expenditure of many millions of dollars. Among those in charge of the exhibit were J. A. Jackson, Nathan Shein, and A. N. Dick, all Assistant Engineers of the Division of Streets, Bureau of Engineering.

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The Atlantic Refining Company entertained the various editors, associates, and advertising men of the technical trade press at an excellent dinner at the Fort Pitt Hotel on Thursday evening, H. B. Stone acting as host. Any of the boys who were there will vouch for it that he made a good one, too, and every one present had a most enjoyable time. A most enjoyable evening was spent after the dinner had been disposed of, excellent stories having been told by all present, and scores of interesting experiences, most of which were more or less personal, were related.

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Allegheny County, of which Pittsburgh is the county seat, also had an interesting exhibit, all of which was photographic, showing the work that has been done in constructing her wonderful road system that, to date, has cost close to eighteen million dollars, all of which was raised by taxes assessed annually, so that no hardship was placed on the tax-payers of the county. The exhibit was in charge of County Road Commissioner William McC. Donley, who succeeded John Gillespie the first of this year, and Addison C. Gumbert, Frank J. Harris, and Gilbert F. Meyer, county commissioners.

Warren Brothers Company, Boston, Mass., occupied a large space, and the exhibit, which was in charge of Earle W. Pimm, the genial and popular manager of the Publicity Department, was most tastefully arranged. The exhibit included a large number of samples of Warrenite, very popular in road construction in Allegheny County, more than one hundred miles having been built in that county alone in recent years, the principal roads being shown by a well-arranged exhibit of photographs. H. M. Agnew, superintendent of the Warren Brothers plant at Boston, was also at the exhibit, as were a number of representatives of the Donald McNeil Company, representatives of the Warren Brothers Company in the State of Pennsylvania. The representatives of this latter concern in attendance were Donald McNeil, Max G. Leslie, A. Lyle Linderman, and C. F. Stang.

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Dan T. Pierce, Executive Assistant of the Barber Asphalt Paving Company, Philadelphia, entertained the representatives of the various technical and road publications at a dinner at the Fort Pitt Hotel on Tuesday evening. After a most enjoyable dinner, an hour or more was devoted to an exchange of experiences, stories, and general jollity.

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The Robeson Process Company, New York City, had one of its customary interesting and attractive exhibits, and as has always been the case in the past, always had a crowd around the booth watching the tests being made on samples treated with glutrin as a binder. The company had a large number of cylinders and briquets made of sand-clay bound with glutrin, and these were broken for the benefit of visitors, as were also similar test pieces made with other binders, so that silently a comparison could be made by those witnessing the tests. In attendance at the Robeson exhibit were L. H. Waddrop, General Manager of the Company; H. H. Hurt, Chief Chemist; Philip Hurt, his assistant; Maurice Young, representative of the company in New Jersey; George J. Martin, representative in Pennsylvania, and Edward R. Lantz. William M. Whitelaw, president of the Glutrin Paving Company, 507 Hartman Building, Columbus, Ohio, was also there in the interests of his company. This latter concern was but recently formed, and from the headquarters in Columbus exclusively handles Glutrin throughout Ohio and considerable adjacent territory. Mr. Whitelaw was, it will be remembered, for several years the Ohio representative of the Robeson Process Company, and has now taken over the business in that territory himself.

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The United Gas Improvement Company, Philadelphia, Pa., manufacturers of Ugite, well known throughout Pennsylvania, Maryland, New Jersey, Delaware, and New York State, as a binder for macadam roads, showed samples of this material, and distributed literature and Ugite buttons. The exhibit also contained a number of fine-looking roads, reproduced for convenience sake by high-class photographs. The exhibit was in charge of W. H. Fulweiler and G. W. Mink, Jr., the former gentleman being in charge of the road department.

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The Garford Motor Truck Company, Lima, Ohio, exhibited two of their standard types of motor trucks. The one which attracted the greater attention was the six-ton truck with the hydraulic hoist, equipped with a five-yard, all-steel body. This truck is the one that is being used by road contractors, highway departments, and others interested in actual road construction in every part of the country. Five of these trucks were recently sold to the Iron City Sand Company, of Pittsburgh, for the rapid and economical delivery of sand to contractors and other users throughout the entire Pittsburgh district, where the hauls are long and the hills and grades many and steep. This concern has thoroughly tried out the Garford Truck, however, and has found that it will carry and deliver its rated capacity to any point required, even under the adverse conditions that are encountered in that district, and they do not hesitate to say that this truck has demonstrated to their entire satisfaction that it will go with its full load anywhere that a contractor or any one else will ask on actual construction work. The other truck exhibited was a one and one-half ton contractor's general utility truck, a fast and economical vehicle for carrying men and materials to and from work when it is in remote districts without other methods of transportation, and for hauling shipments from the railroad to the work when sid-

ings are not conveniently located. S. M. Williams, sales manager of the company, was in charge of the exhibit, and after the first day found that he had to keep three men busy handing out his Good Roads Booklet, so popular yet, in spite of the fact that nearly two hundred thousand have already been distributed in every part of the United States, Canada, and Mexico. This booklet, which was published in BETTER ROADS AND STREETS last summer, is without question, the most popular piece of good roads literature that has ever been written and distributed, and is being used in connection with standard textbooks by the students in highway engineering courses in almost every college and university in this country.

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The exhibit of the Hastings Paving Company, New York City, and that of the Asphalt Block Pavement Company, Toledo, Ohio, which were housed in the same booth, attracted a great deal of attention. In fact, it was impossible to have the exhibit overlooked, owing to the brilliancy of the large electric sign adorning the booth. The exhibit consisted of full-size, cross-sections of asphalt block pavement, a model of an asphalt block road, a model rattler used in the testing of asphalt block, the blocks themselves, and the various materials which enter into the construction of the block.

The Hastings Pavement Company was represented by George P. Hempstreet, superintendent of the plant at Hastings-on-Hudson, New York, and an authority on asphalt block manufacture and asphalt block pavement construction; P. L. Thompson and T. J. McNally, of the sales force of the company.

The Asphalt Block Pavement Company was represented by C. A. Luck, General Manager; Frank Rodgers, Construction Superintendent, and A. E. Cohen, of the Sales Department.

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F. D. Cummer and Sons, Cleveland, Ohio, showed photographs and drawings of their different types and sizes of asphalt repair plants for cities desiring to repair and maintain their own asphalt pavements. The exhibit was in charge of I. Preeman, of Cleveland.

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The exhibit of the Matthews Gravity Carrier Company, Elwood City, Pa., created a great deal of interest among the paving contractors. It showed the actual handling of paving brick and cement in sacks from care or delivery trucks to the point on the work where they were wanted for use, demonstrating that brick can be delivered direct from the piles along the street to the men laying them without the necessity of having four or five men carrying the brick to the men who are placing them. The exhibit was in charge of A. F. N. Thomas, Sales Manager of the company; W. L. Dean, Secretary, and F. E. Moore, General Manager. F. A. Francois, of the sales and engineering force, was also there.

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The Keystone Driller Company, Beaver Falls, Pa., had one of their Keystone Traction Excavators in actual operation in the open space outside Machinery Hall, and needless to say, it attracted a great deal of attention. The machine is a combination steam shovel, ditcher, and grader, making it a particularly valuable combination for the road contractor or the road department undertaking work by force account. This concern also had a booth inside, which was in charge of J. Vail Downie and Will R. Cook.

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The Blaw Steel Construction Company, Pittsburgh, Pa., exhibited a complete line of its various products used in the construction of streets and highways. And this means that they make something for every purpose, including steel forms for concrete roads and for brick highways constructed with concrete curbing or edging; combination curb and gutter forms, straight curbing forms, and flexible curb and curb-and-gutter forms that will conform to any radius desired; and collapsible box and other culvert forms. It is needless to mention that all forms manufactured by this well-known company are of steel. The exhibit was in charge of C. H. Lehman, secretary of the company; Edward M. Ornitz, good roads engineer, and J. A. Cullison, publicity manager.

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One of the largest and most interesting exhibits at the show was that of the Good Roads Machinery Company, Kennett Square, Pa. This exhibit included a ten-ton Monarch macadam roller equipped with a scarifier attachment, a five-ton tandem type asphalt roller, a Little Winner road grader, a Champion all-steel road drag, a Fort Wayne road drag, American Cast Iron Culvert Pipe, and American Corrugated Iron Culvert Pipe. The exhibit attracted particular attention, due to the fact that the large macadam roller was kept running most of the time. W. E. Voorhees, secretary of the company, was in charge of the exhibit, assisted by a large force, including W. D. Riggs, manager of the Pittsburgh office; W. M. Bryant, West Virginia representative, with headquarters at Fairmount; A. M. Taylor, representative at Youngstown, Ohio; N. J. Burns, representative at Greenville, Pa.; R. C. Lepley, representative at Altoona, Pa., and J. M. Bishop of the Pittsburgh office. The Good Roads Machinery Company advises that the show was an excellent one for them, as they sold every piece of equipment they had on the floor, as well as such additional road-building equipment to be delivered after the close of the show to road contractors, etc.

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The United States Asphalt Refining Company, 90 West Street, New York City, together with the Bitoslag Paving Company, of the same address, occupied a large space at one end of the exhibit hall. Both showed numerous photographs of their products. The United States Asphalt Refining Company carried out its usual decorative scheme, emblematic of its well-known product, "Aztec Asphalt," while the Bitoslag Paving Company showed an actual section of its pavement taken from a road near McKeesport, Pa., which had been in service for five years, with little or no signs of year, and no signs whatever of any disintegration. Air-cooled, blast-furnace slag is the metal used in the construction of this pavement, the various graded sizes being bound with Bitoslag cement.

Those in charge at the exhibit were Joseph R. Draney, sales manager; J. C. Rock, general agent; George B. McGrath, southern manager; Gordon Smith, New York State and Canadian sales agent; A. J. DeWine, Ohio and Kentucky representative, Columbus, Ohio; C. B. Filbert, Pennsylvania Representative; P. J. Weedon, Philadelphia, Pa., sales manager; J. T. Swartz, manager of the Eastern Paving Company, Philadelphia, Pa., and Leroy M. Law, chief chemist, Baltimore, Md.

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One exhibit was not enough for the Orenstein-Arthur Koppel Company, Pittsburgh, and Koppel, Pa., so one space was taken in the Exhibit Hall, and another outside. The outside exhibit consisted of a one-hundred-foot section of portable industrial track on which operated a Koppel dinkey locomotive with the new type of double side dump cars and a combination track-laying and service car, the latter demonstrating how simple it is to lay this kind of track. This exhibit attracted a great deal of attention. The inside exhibit consisted of a standard, double-side dump car with samples of the improved rail connections now being manufactured, clutch-bolt ties and the improved, self-oiled roller bearings. The two exhibits were in charge of B. H. Behrens, Sales manager; J. Blanck, New York manager, and Messrs. E. J. Shellaby, R. N. Lowry, and A. J. Kraft, of the sales department.

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The Duquesne Slag Products Company, represented by C. L. McKenzie, Pittsburgh, and John Goehring, Philadelphia, showed a full line of all sizes of commercial slag for all purposes, and distributed literature of more than ordinary interest to road engineers.

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The Asbestos Protected Metal Company, Pittsburgh, Pa., showed its new Pittsburgh Asphalt Paving Joint for streets and roads. This joint is a pure asphalt paving joint. The exhibit was in charge of Samuel T. Farquhar, R. G. Miller, and D. W. Dryden, all of the Pittsburgh offices of the company.

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Four interesting road models, built to a scale of one inch to the foot, were shown at the exhibit of the Atlantic Refining Company, Philadelphia, Pa., and attracted considerable attention and much favorable comment. These models illustrated water-bound macadam road construction, bituminous macadam, penetration method, asphaltic concrete construction, and sheet asphalt pavement. There were also cross-section samples of sheet asphalt, National pavement, Filbertine, Soilamies, Unionite, and Soil-Amiesite, in all of which Atlantic Asphalt was

used. At the exhibit were found R. D. Leonard, General Manager of Domestic Sales; W. J. Patterson, manager of the Pittsburgh Sales Department; Fred S. Burke, assistant manager of the Pittsburgh Sales Department, and Frank F. Ablett, R. G. Patterson, and N. B. Stone of the Sales Department.

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The Bituminized Road Company, Kansas City, Mo., and the National Pavement Company, Scranton, Pa., united in exhibiting National Pavement, showing sections of the pavement and the bituminized earth that is used in its construction. The joint exhibit was in charge of J. Edgar Black, of Kansas City, Mo., and Fred Church, Scranton, Pa.

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The Dunn Wire-Cut Lug Brick Company, Conneaut, Ohio, exhibited a full-sized section of pavement built of Wire-Cut Lug Brick, and smaller sections of monolithic construction on green concrete base, and brick pavement on a cement-sand cushion. The established custom of distributing carnations was not overlooked, and Frank Dunn was kept busy pinning them on his hosts of friends. The exhibit was in charge of Frank Dunn, president of the company; William C. Perkins, chief engineer; W. T. Blackburn, consulting engineer; F. T. Townsend and H. G. Lehrbach, assistant engineers, and R. T. Stull, ceramic engineer.

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A six-foot section of Cast Iron Culvert Pipe at the booth of the Cast Iron Manufacturers, attracted much attention. The section weighed eight tons, and was a giant compared with the

(*Continued on page* 44.)

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## Report of Committee on Resolutions

(*Continued from page* 28.)

cost, to secure a flat subgrade, or one nearly flat, such increase is advisable.

**Width.** The desirable width for single-track road is ten feet. The desirable width of double-track roads is eighteen feet. The total width of the roadway should be not less than twenty feet for single-track roads and not less than twenty-six feet for double-track roads.

**Crown.** The crown of roads and pavements should be not less than one one-hundredth nor more than one-fiftieth of the total width. Except in unusual cases, one one-hundredth of the total width will be sufficient for country roads, and one-fiftieth will be considered satisfactory for alley pavements. For city streets, an average crown of one seventy-fifth will generally be found sufficient, and should not be reduced, except on grades.

VII. Joints.

**Transverse Joints.** Joints should be placed across the pavement perpendicular to the center line about fifty feet apart.

There seems to be a tendency to widen the distance between joints.

Joints should extend entirely through the pavement, as well as through the curb if integral curbs are used. Joints should be constructed perpendicular to the surface of the pavement to avoid the possibility of one slab rising above the other.

**Longitudinal Joints.** Longitudinal joint filler should be staked or otherwise securely held against the curb. Joint material should also be placed around manholes, catch-basins, etc.

**Protected Joints.** The tendency of present practice is toward the omission of metal protection plates for joints. It is possible that the value of metal protection plates is dependent somewhat on the character of aggregate used, and it is considered that they are more essential in street pavements than in country highways.

**Plates.** Plates for protected joints should be wired together with the joint filler in place and securely held in the installing bars. When short sections of joint filler are used they should likewise be wired together. Supports for the joint should be used when the pavement is of such width that the installing bar deflects. On wide streets every joint should be checked as to crown with sighting T's. When necessary to have joint plates in two sections, the contractor should arrange with the manufacturer to have holes drilled in the abutting ends of the plates so that the plates may be securely wired or strapped together. As the joint plates usually do not fit tight to the installing bar, a quarter-inch shim is placed under each end of the installing bar, to insure that the plates are not covered by the concrete.

VIII. Mixing and Placing Concrete.

**Measuring.** The method of measuring materials for the concrete, including water, should be one which will insure accurate proportions of each of the ingredients at all times. It is recommended that a sack of Portland cement, containing ninety-four pounds net, be considered as equivalent to one cubic foot.

**Proportioning.** The proportions should not exceed five parts of fine and coarse aggregate, measured separately, to one part of Portland cement, and the fine aggregate should not exceed forty per cent. of the mixture of fine and coarse aggregates.

**Aggregates.** Bank-run material shall not be used. Proportioning based on sieve analysis or by relative density tests is not practical for concrete roads except where laboratory direction is available. But where proper facilities are available, the above proportions should be varied as the tests warrant.

**Mixing.** The ingredients should be mixed in a batch mixer of approved style, and the size of the batch should not exceed the rated capacity of the mixer. The mixing should be continued for at least one minute after all materials are in the mixer and before any of the concrete is discharged. The speed of the mixer should not be less than ten revolutions per minute; however, the time, and not number, of revolutions, should be the factor for determining proper mixing.

**Consistency.** The practice is to mix concrete entirely too wet. The consistency should be such as not to require tamping, but not so wet as to cause the separation of the mortar from the aggregate in handling and placing. The strength and wearing qualities of the concrete are vitally lessened by an excess of water in mixing.

**Placing.** If the subgrade has been disturbed by teaming or from other causes, it should be brought to its former surface, and thoroughly saturated with water. The concrete should be deposited rapidly to the required depth and width. The section should be completed to a transverse joint, without the use of intermediate forms or bulkheads, or a transverse joint may be placed at the point of stopping of the work. In case the mixer breaks down, the concrete should be mixed by hand to complete the section. Where reinforcement is used it should be embedded in the concrete before the concrete has begun to harden; and the concrete above the reinforcement should be placed within twenty minutes after the placing of the concrete below.

In two-course pavements, the top should be placed within twenty minutes after the placing of the bottom.

**Finishing.** The surface of the concrete should be struck off by means of a template moved with a combined longitudinal and transverse motion. The excess material that accumulates in front of the template should be uniformly distributed over the surface of the pavement except near the transverse joint, when the excess material should be removed.

The concrete adjoining the transverse joint shall be dense, and any depressions in the surface shall be filled with concrete of the same composition as the body of the work. After being brought to the established grade with a template, the concrete should be finished to true surface with a wood float, used from a suitable bridge. A metal float (trowel) should not be used.

Brooming of the surface is not necessary, and grooves are objectionable even on grades.

IX. Retempering.

Retempering of mortar or concrete which has partly hardened, that is, mixing with additional materials or water, is strongly condemned and should not be permitted.

X. Protection and Curing.

Even the best concrete may be seriously damaged by too rapid drying out, early exposure to low temperature, or by being opened to traffic at too early a period. Hot sun and drying winds are most likely to dry out the concrete too rapidly, thus causing shrinkage cracks or causing a surface which will not wear well under traffic. The use of a canvas covering will be found effective in overcoming this condition.

Sprinkling should also be employed as soon as the concrete is hard enough to prevent the surface from being pitted. An earth covering or protection by "ponding" should be employed after the first day. Under most favorable conditions, such protection should be given to the pavement for at least two (2) weeks. Water should be added during this period to keep the concrete wet.

In cool weather, it is often advisable to omit the earth covering, thus allowing the concrete to harden more rapidly. Sprinkling should not be omitted during the day in case the surface shows a tendency to dry out. When there is danger of frost, sprinkling should be omitted and a covering of canvas or of straw and canvas used.

Placing concrete roads, etc., in temperatures at or near freezing, is not advisable; but if in special cases such work is unavoidable, the water and aggregate should be heated and fresh work protected, and precautions taken to protect the concrete from freezing for at least ten days. Chemicals should not be used to lower the freezing temperature of the mixture.

Concrete should not be deposited on a frozen subgrade.

XI. Opening to Traffic.

Under most favorable conditions a concrete pavement should not be opened to traffic in less than two weeks after the last concrete has been placed; and when conditions permit, this interval should be increased to four weeks.

One-Course Pavement.

Where the materials most readily available are such as to give good construction in one-course pavement, this Conference recommends that the one-course be used.

XII. Integral Curb.

The integral curb for concrete street pavements is recommended in preference to straight curb or combined curb and gutter. Such construction eliminates the longitudinal joint along the curb, and maintains a permanent grade and alignment. Precaution should be taken to insure that the curb is thoroughly bonded to the pavement proper. The integral curb can be used on wide as well as on narrow streets.

XIII. Specifications.

Since no specifications were considered by the Conference the Standard Specifications for Pavements and Roadways of the American Concrete Institute are recommended.

(NOTE—The report is given in full with the exception of some of the introductory resolutions, abstracted for the sake of brevity.)

# Better Roads and Streets

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Subscription Agents Wanted Everywhere. Good Commissions


Good roads will never come till we change our views and keep them changed.

* * *

Left to themselves, a dirt road and a rain will always mean mud.

* * *

We all want good roads, but it takes money to pay for labor and material.

* * *

Bad roads cannot be improved by standing around and "cussing" the country.

* * *

It is folly for the tax-payers to demand good roads unless they are willing to contribute the money needed to build them.

* * *

If you don't get a new road by your own door this year, try to maintain what you already have. A shovelful in a little depression to-day may save a cartload next month.

* * *

One of the great things the automobile has done for the country is to make clear to everybody the necessity for good roads.

* * *

Have you heard any one say, "I am so glad to get to town. I have not been away from home since before Christmas because the roads have been so bad"?

* * *

What this country needs is all-year-round roads that will remain in good condition, no matter what the weather conditions.

* * *

Any good road will serve all the people alike—the rich, the poor, the high and the low, the pedestrian, the truckman, the farmer, and the motorist.

* * *

It is folly to contribute money to build roads unless there be a prior understanding that they are to be well built and properly maintained.

* * *

The photograph from which the front cover of this issue was made, shows Capitol Boulevard, including the State Capitol at Nashville. Tennessee, which boulevard was laid with Bithulithic in 1913.

* * *

Should you be out riding and you find the riding rough, don't condemn the type, but take a second look and see if the cause is not a lack of drainage. Drainage is even more essential than type.

Two things needed to make the good-roads movement in any county and State a success may be stated in a few words: They are—adequate funds, substantial construction, and intelligent maintenance.

* * *

One more road convention is now but a memory. As it was not a National Road Congress, however, let us all hope that the next one will actually be *national,* which will positively insure its success, as manufacturers of machinery, road officials, and contractors will all attend it and lend their support.

* * *

Take care of the ruts in your earth roads and you will find that the roads will amply reciprocate by taking good care of you while you are using them. The road drag is the worst enemy that ruts have to contend with, and the best friend to the earth road.

* * *

If we give our roads the maintenance they should have, regardless of the type, we will find that it will be a long time before we will have to repair them. Why, then, should we overlook the most important thing that tends to keep the roads healthy?

* * *

Evidence is piling up at a rapid rate, substantiating our contention of several years' standing, that maintenance by the patrol system is the most economical and the most satisfactory system in the end. Illinois is the latest department to be converted.

* * *

Roads are the greatest of all public utilities. They belong to the people and the most important road of all is the road leading from your own door yard. However, should your county not build the road past your own door this year, then don't oppose the road to be built by your neighbor's door.

* * *

We, as people, are not paupers, and there is no occasion for poor roads in any community. That such roads do exist is simply an evidence that we as citizens are not alive to our opportunities or our duty, and that so long as we sleep, we may expect our officials to share our slumbers.

* * *

We will soon begin maintaining what we now have, and constructing new roads. See to it that your county adopts some system whereby you can find out the cost of maintaining any mile of road in your county as well as the cost of new construction.

* * *

Perhaps you have seen or heard of people walking from their country home to town and you have no doubt wondered why they did not ride horseback. Don't you know that a horse has four feet to pull out of the mud, while a human being only has two?

* * *

We believe in preparedness by increasing our navy, increasing our army, and in building coast defenses, but why so much money for the army, navy, and coast defenses, and nothing for roads, when roads will prove to be useful in times of peace as well as in war?

* * *

Maintenance Means Many More Miles. Neglect means—Well, the best evidence of what it means to any road is to go out and look at one that is worn out after having been used but a comparatively short time. And almost every mile of those roads would have had its life doubled, trebled, or even quadrupled had they had the proper maintenance.

* * *

Perhaps you know of a road before winter began that was in splendid condition, but is now rough, and in some places almost impassable. Don't let this convert you into a "knocker." Visit the road and find out the trouble. You must also realize that the past winter has been one of the worst years ever experienced on roads.

* * *

Do not overlook those earth roads now. April brings, or should bring, abundant rainfall, and never forget that every good rain should bring out thousands of road drags. Also bear in mind that every road drag properly used on your earth roads means an increased mileage of earth roads that will be a

# How did *your* roads come through the winter?

ARE your macadam roads frost-proof? Are they in good condition this spring? Or are you now going through a season of dirt and mud "while the frost is coming out"? In a typical American township today are these examples of "spring" roads:




*Note the clean, smooth, dustless Tarvia surface.*

**Case 1. Old plain macadam**

Worn down by automobiles, exposing the uneven basic mosaic which has caught water, and suffered severely from disruption by frost. Considerable loose stone. Mud now—dust later. No relief till warm weather when expensive resurfacing will be in order. Deterioration is 40%.

**Case 2. New macadam last year**

Still a good road but with a one-inch film of mud in wet weather and dust in dry. The smooth "roof" of the road is being destroyed. Already the road fails to shed water promptly, although the foundation is still intact. Deterioration 15%.

**Case 3. Oil macadam street treated with oil to suppress dust**

Effect of the oiling has worn off. Plenty of dust now, or slimy black mud. Deterioration going on steadily because the oil had no bonding or dust-preventing power—it merely made the dust too heavy to blow. No relief in sight. After mud dries dust must blow till weather is warm enough for re-oiling. Can't even sprinkle with water on account of the old oil.

The foregoing represents the result of old and wasteful methods of road construction. We will now tell you of results where newer and more economical methods were used.

**Case 4. Old macadam treated last year with a coat of "Tarvia-B"**

Applied from a sprinkling cart, the Tarvia soaked into the surface forming a sort of tough tar-concrete. Sheds water like a duck. No mud or dust. No deterioration. Looks as good as it was last fall. Needs only light renewals of "Tarvia-B" to make it better than ever.

**Case 5. New macadam built with heavy "Tarvia-X"**

Constructed layer by layer three years ago. The Tarvia cements the stone together in a traffic resisting layer. It added slightly to the original cost but saved much stone and labor. Clean, dry and smooth. If it shows any wear a light coat of "Tarvia-B" restores it to prime condition.

Tarvia makes macadam frost-proof, winter-proof and automobile-proof. It is a tough, dense, viscid binder, a plastic cement that defies water, weather, and traffic.

Expense? Tarvia adds a little at the beginning and saves a lot in the end on the obvious principle that it is cheaper to have a road that will easily withstand modern traffic than to keep on renewing an inferior type of surface that is too weak for the traffic.

A road that pulverizes and abrades under the attrition of the backward kick of the automobile driving wheels is an expensive nuisance nowadays. That is why the plain macadam road is disappearing.

Durable, dustless tarvia-bonded roads really cost *less* than dusty, water-bonded macadam roads owing to their longer life and lower maintenance costs.

There is a Tarvia process for most road problems.

**Special Service Department**

This company has a corps of trained engineers and chemists who have given years of study to modern road problems The advice of these men may be had for the asking by any one interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

*Illustrated booklet on request.*

New York Chicago Philadelphia
Cleveland Cincinnati Pittsburgh
Kansas City Minneapolis Salt Lake City

The Barrett Company

Boston St. Louis
Detroit Birmingham
Seattle Peoria

THE PATERSON MANUFACTURING CO., Limited: Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S

pleasure to drive over, and over which your horses can haul a fair load.

* * *

As you are reading this page of Better Roads and Streets, do you realize that the frost is out of the roads in most sections of this country, and that the first thing your mind should turn to is *maintenance?* Proper maintenance means taking care of the ills that are found in any road while these ills are small and insignificant. This applies alike to our earth roads, water-bound macadam, bituminous concrete, bituminous macadam, asphalt macadam, tar macadam, concrete, and brick highways.

* * *

An improved road is an investment and should draw interest in the form of traffic. Neglect the investment, however, and the interest will soon cease because the traffic will see that it costs too much to make use of the investment, and other routes will be sought out and taken. Then it is not hard to see how towns and villages along the first investment will suffer through the loss of this traffic and the business it is certain to bring.

* * *

You know that Wayne County, Michigan, is famous for its concrete roads, and that Cuyahoga County, Ohio, is famous for its large mileage of brick roads, but do you know that Philadelphia County, Pennsylvania, is equally famous for its bituminous-treated, water-bound, macadam roads, and Franklin and Wood counties, Ohio, for their water-bound macadam roads? If you are not familiar with these latter facts, it will pay to investigate these roads.

* * *

Did you notice during March any four- or six-horse teams hitched to a load that would ordinarily require but two horses? Have you noticed whether any of the school children missed school because of road conditions? Have you missed getting your mail because the rural mail carrier could not make his regular trip because of the impassable condition of your road? If you have noticed the above conditions, then don't forget it when the road levy proposition comes up, and don't remain away from the polls or vote against it.

* * *

William I. Alling, for the past eight years with the Eureka Machine Company, Lansing, Michigan, has been appointed manager of the Concrete Mixer Department of the Lansing Machine Company, to succeed Mr. W. G. Jenkins, whose resignation is noted elsewhere in this issue.

* * *

This month is the time to look after the edges of your hard-surfaced roadways. You will find that there are many ruts along the edges, caused by traffic turning out on the shoulders while the latter are soft and wet. The shoulders will also be found to be more or less disturbed and cut up. Crushed stone placed on the shoulders in such quantities as the conditions demand, and likewise in these ruts at the edge of the pavement surface, will save both the pavement and the shoulders, and will incidentally save a lot of money that will otherwise have to be expended for repairs.

* * *

## The Annual Good Roads Show

(*Continued from page* 41.)

section of three-inch culvert pipe, which was placed alongside. The exhibit was in charge of R. C. McWane, Publicity Manager of the United States Cast Iron Pipe and Foundry Company, assisted by R. L. Strowbridge, Publicity Engineer of the same concern.

W. D. Craven, assisted by Herbert Spencer, had charge of the exhibit of the Standard Oil Company of New York, who exhibited samples of refined Mexican and California asphalts, asphaltic road oils, road binders, paving fluxes, and joint fillers.

Joseph N. Early, New York City, showed a full line of street and road signs set in frames, the latter being made of malleable iron castings, insuring their strength and durability. The signs themselves were all enameled metal, and very attractive.

The Standard Oil Company of Indiana showed a full line of road-building products marketed by this company. The exhibit was in charge of F. P. Allen, Sales Manager, and W. H. Myers, both of Chicago, Ill., the general offices of the company.

The Holtzel Steel Form and Iron Company, Warren, Ohio, showed a complete set of the "H-H" steel forms for street and roadway pavements and sidewalk construction, and also a car unloading chute, which attracted a great deal of attention. Not the least interesting part of the exhibit was a very complete line of photographs taken during actual construction, showing the use of this well-known concern's forms in sidewalk and road construction. The exhibit was in charge of J. McNeilly and M. C. Boyd.

Although the exhibit of the Galion Iron Works and Manufacturing Company, Galion, Ohio, was delayed by the freight congestion in and around Pittsburgh, the exhibit arrived several days before the show closed, and was the center of much attraction. The exhibit consisted of several pieces of road-building machinery, including the "Premier" and the "Light Premier" road machines, the Galion "Ideal" combination scarifier, and corrugated and cast-iron culvert pipe, together with a large collection of actual working models of other lines of road-building and maintenance equipment manufactured by this enterprising and well-known concern. One of the most interesting models was the "Eclipse" car unloader, hundreds of which are in use in all parts of the country. The exhibit was in charge of O. P. Beck, General Sales Manager; J. G. Finley, Pittsburgh Sales Manager; R. E. Forsythe, Eastern Sales Manager; J. M. Patterson, Sales Manager, and William Patterson, John Laird, W. L. McCracken, and H. W. Finley, of the Sales Department.

The Sterling Motor Truck Company, Milwaukee, Wisconsin, exhibited four motor trucks, all equipped with dump bodies for contractors and others requiring this type of body. These trucks were of seven-ton, five-ton, three-and-one half-ton, and two-ton capacities, and were shown in operation. The exhibit was in charge of Charles T. Topping, president of the Topping Machinery Company, Pittsburgh, local representatives of the company, and W. T. Bradt, of the same concern.

John Baker, Jr., New York City and Chicago, had a large exhibit space and a large force of representatives on hand to explain the merits of the new brick just being placed on the market. This brick is known as Aspha-Brick, manufactured by the Aspha-Brick Corporation, of which concern John Baker, Jr., is president. There were also exhibited samples of road oils, asphalts, and other products used in road construction and maintenance. The representatives in charge of this exhibit were W. F. Kershaw, New York City; D. A. Kennedy, and M. M. Cranston, Boston; C. F. Hepburn, W. L. Hempelmann, L. R. Machenzie, and William Howe, Chicago; Louis W. Gay, Buffalo; Theodore C. Jacoby, St. Louis; M. E. McDonough, W. J. King, and W. E. Tyer, Philadelphia; J. J. Gartland, Jr., and W. R. Macatee, Richmond, Va., and O. E. Rankin and S. R. Murray, Toledo, Ohio.

The Locomobile Company of America, Bridgeport, Conn., exhibited three motor trucks, each equipped with a different body for use in road work and the transportation of men. Two of these were four-ton trucks and the other was of three tons capacity. The exhibit was in charge of J. A. Dahlburg and E. J. Dick, of Bridgeport, and J. H. Stuebe, manager of the Pittsburgh branch of the company.

The Koehring Machine Company, Milwaukee, Wis., showed one of the big No. 11 paving mixers which attracted a great deal of attention, as it was almost constantly in operation. The new "Dandie" mixer which this company is now building, was also shown. The exhibit was in charge of W. J. Koehring, Superintendent of Construction of the Koehring Company; Charles T. Topping, and W. H. Bradt, of Pittsburgh; Lee T. Ward and S. J. Twitchell, of Philadelphia, and W. W. Williams, of Columbus, O.

The Pennsylvania Dolorway Paving Company, Pittsburgh, Pa., showed several sections of Dolorway paving taken from as many cities. The exhibit was in charge of Samuel Gamble, president of the company; W. D. Hill, treasurer, and Matthew Johnston, superintendent.

The Ball Engine Company, Erie, Pa., manufacturers of the Erie Steam Shovel, had expected to have a shovel in operation, but it was decided that this would be impossible, owing to the fact that this company is operating its plant to capacity, and one of the shovels could not be spared. The exhibit was in charge of D. H. DuMond and P. B. Haisey, of the general office, and Harry Kleinhans, the Pittsburgh representative.

The Concrete Products Company, 803 Diamond Bank Building, Pittsburgh, Pa., had an interesting exhibit of reinforced concrete guard rail for highway work, and reinforced concrete culvert pipe. Those in charge of the exhibit were C. F. Buente, General Manager; J. M. McFarlin, Sales Manager, and Ralph Berry, Office Manager.

The Contractors' Machinery and Supply Company, Pittsburgh, exhibited Lansing paving mixers and the Richmond concrete mixer. The exhibit was in charge of Alfred Hirsch, Sales Manager, and C. L. Adams, Assistant Sales Manager.

The Pierce-Arrow Motor Car Company, Buffalo, N. Y., demonstrated their two-ton dump body, the five-ton dump body, and a three-ton chassis. The exhibit was in charge of the McCurdy-May Company, Pittsburgh distributors.

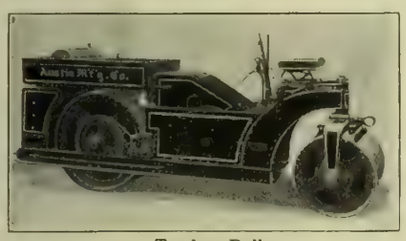
# Modern Municipal Road Authorities

demand as much uniformity and smooth working in their road and street equipment as they would in a well-selected fire fighting outfit.

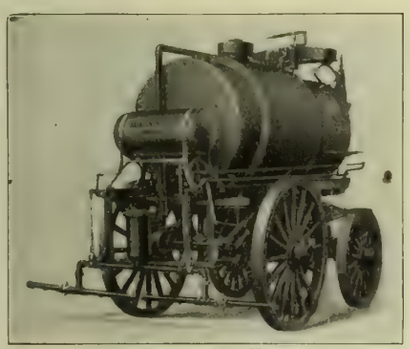
## The Austin-Western Road Machinery Company

build an entire line of road and street machinery in their own factories. Each machine made under supervision of experts, all coöperating to produce the best and most suitable equipment for modern requirements. A well balanced, up-to-date Austin-Western road equipment works with uniformity and with the objects of efficiency and economy in view. Saving of time, money and trouble is the resulting service to the owner.

THE AUSTIN-WESTERN LINE INCLUDES:

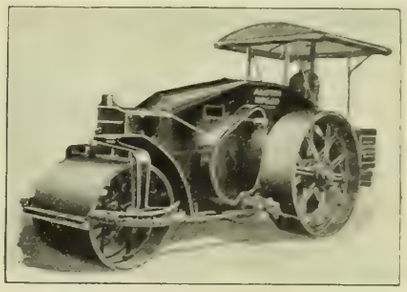


Tandem Roller

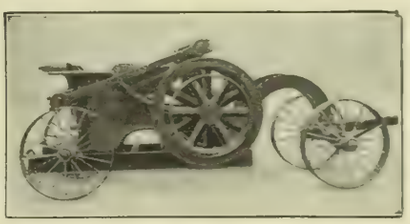


Oiler with Heater

**Motor Road Rollers,**
**Motor Tandem Rollers,**
**Road Scarifiers,**
**Rock Crushers,**
**Portable Stone Bins,**
**Stone Screens and Elevators,**
**Road Oilers,**
**Sprinklers,**
**Sweepers,**
**Stone Spreaders,**
**Dump Wagons,**
**Earth Handling Tools, Etc.**



Macadam Roller



Jaw Rock Crusher

*Write for new edition of* ***Road Builder's Guide*** *now ready.*

# The Austin-Western Road Machinery Co.

Chicago, Illinois

Agents and Warehouses Covering Every State in the Union.

# This Littleford Portable Tar Heater No. 48

is indispensable for Highway Contractors or Municipal Departments of Street Repairs.



This Heater is fully described on page two of our Catalog B. This catalog will be sent to you free. Send for your copy to-day—it lists many other items of interest.

**LITTLEFORD BROS.,** 400 E. Pearl St., Cincinnati



**EXPANSION**




**JOINT COMPOUNDS**

## ENGINEERS AND CONTRACTORS

You are interested in up-to-the-minute products for construction work, therefore, you are interested in expansion joint compounds.

Do you have specifications for expansion joint?

Are they as rigid as those for your other materials?

If not, they should be.

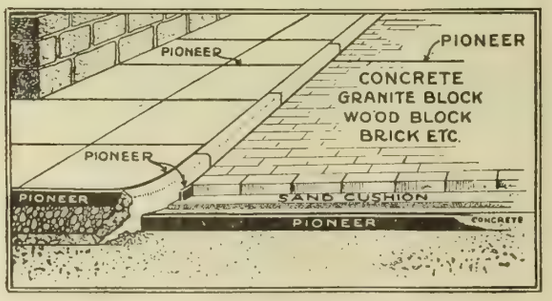
To insure the longest period of usefulness for your roads, to protect your city and prestige, you should use only the most approved, pure asphalt, expansion joint. There are no joints which can compete with "PIONEER" on the quality and endurance tests. The materials used in "PIONEER" are of the highest quality and the principle is correct.

We will be pleased to receive your inquiry for samples, literature and prices. Don't buy before getting them.

## THE PIONEER ASPHALT COMPANY

*Producers of Highest Quality Bituminous Products*

LAWRENCEVILLE, ILLINOIS




TELL 'EM YOU SAW IT HERE.


After the side ditches have been cleaned out and the berms, or shoulders, have been trimmed, dispose of this material for good, but do not do this by throwing it over on the center of the roadway surface to be ground into the earth or sand-clay roadway by traffic. When this material has once been removed, it is dead. It has no more life in it than a mummy in a dime museum.

* * *

## Large New Factory and Warehouse for Wheeling Corrugating Company

About April 1 the Chicago branch of the Wheeling Corrugating Company will move into their newly-constructed factory and warehouse building at 2547-61 Arthington Street, Chicago, Illinois.

Located for many years on North Clinton Street, near the center of the city, the Chicago business outgrew the old, five-story building and made new quarters a necessity. The new building is located in an important manufacturing district about three miles west of the "Loop" along the Pennsylvania Railroad. It is of the most modern reinforced concrete type, four stories high, each floor having an area of about fifty thousand square feet.

With large stock-room facilities, and served directly by a railroad siding, orders for almost any amount of corrugated culvert pipe and road machinery, as well as the other products, such as galvanized and black sheets, corrugated sheets, conductor pipes, stamping ware, etc., can be shipped on the day they are received.

For the Wheeling line of one-piece corrugated culverts, the new plant will serve merely as a warehouse, the fabrication being done, as formerly, at Minneapolis. The greater part of the machinery at the Chicago plant consists of large presses for making the B crimp and pressed and standing seam roofing.

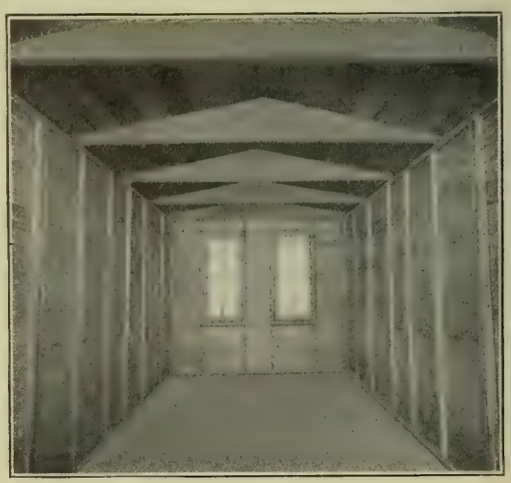
The Chicago offices of the company will also be located in the building.

* * *

## Ready-to-Erect Buildings

"Ready-to-erect Buildings" is the title of a pamphlet issued by the Peerless Buildings Company, Chicago, Illinois. It would be worth while for engineers and contractors alike to send for a copy.

Originally devoting their attention to portable garages only, the Peerless Buildings Company have branched out into many



Interior of a Portable Building

other fields, such as real estate offices, summer cottages, boat houses, railroad switch houses, and, more recently, road contractors' and engineers' field offices, tool houses, etc. Many advantages of portable buildings on road work are thought of at once. The Peerless Buildings Company are prepared to tell you a lot more.

* * *

## The Road Bill now before Congress

One of the most important and pressing matters with which Congress must deal at its present session is the subject of good roads. A month ago, or more, the "Shackleford Bill" passed

the House by an overwhelming majority and was sent to the Senate. It carried no appropriation, but rather a maximum limitation to any appropriations of $25,000,000 out of the general treasury to aid the States in the construction and maintenance of rural post roads, and was sent to the Senate for its consideration. There was something of a passing flurry in that body as to which committee the measure should be referred, which was amicably adjusted by reference from the Committee on Agriculture and Forestry to the Committee on Post Offices and Post Roads. That committee has completed its work and reported a bill very much like the House measure in its general terms, but differing in important features from the House bill to such an extent as to make it, as it has been described by one of the experts who has made a lifetime study of this problem, "the best roads measure that has ever been proposed in the national legislature."

The Senate bill, which has been pressed with fine intelligence by Senator Bankhead, of Alabama, provides for the year ending June 30, 1917, an appropriation of $5,000,000; for the year 1918, an appropriation of $10,000,000; for the year 1919, an appropriation of $15,000,000; for the year 1920, an appropriation of $20,000,000, and for the year 1921, an appropriation of $25,000,000. The management, distribution, and expenditure of the appropriations so provided are to be entrusted to the Secretary of Agriculture, and under conditions, clearly stated in the measure, which he is directed to require. These conditions, briefly stated, are to prevent the waste of the funds taken out of the Federal Treasury so that each dollar expended in the work of making good roads shall have a dollar's worth of work to show for it. "The Secretary of Agriculture is authorized to co-operate with the States"; "the Secretary of Agriculture and the State Highway Department of each State shall agree upon the roads to be constructed therein and the character and method of construction." After making certain clearly stated deductions to cover the expense of administration from the fund provided by the United States, "the Secretary of Agriculture shall apportion the remainder of the appropriation for each fiscal year among the several States," one-third in the ratio which the area of each State bears to the total area of all the States; one-third in the ratio which the population of each State bears to the total population of all the States, and one-third in the ratio which the mileage of rural delivery routes and star routes in each State bears to the total mileage of rural delivery routes and star routes in all the States at the close of the next preceding fiscal year. "The Secretary of Agriculture and the State Highway Department of each State may jointly determine at what times, and in what amounts, payments, as work progresses, shall be made under this act, and payment of these amounts is to be made by the Secretary of the Treasury on warrants drawn by the Secretary of Agriculture. All road projects under this act are to be approved by the Secretary of Agriculture before they can be made a charge against the appropriations made by Congress, the act providing that he shall approve plans, specifications and estimates. The States or their subdivisions must maintain the roads built with Federal aid, for the Secretary of Agriculture is authorized to withhold further such aid where maintenance is not properly carried on.

The Senate bill is a purely business measure. There are no politics in it, no sectionalism, no favoritism, or no partisanship. The conditions are plain and simple—ratio in area, in population, in mileage. Better than all this, however, is the provision that the building of good roads for postal purposes, which will be available for industrial and commercial purposes also, is to be a co-partnership matter between the Nation and the States. The United States will match dollars with the States. Under the conditions noted in the bill, the United States will pay a dollar to the States for the building of rural post roads for every dollar they spend for the same purpose; no more and no less. It is to be a "fifty-fifty" affair between the United States and the States. The States that pay nothing on their own account will get nothing, under the terms of the bill, and whatever the States do in road-building under this bill must be done under the supervision and with the approval of the Secretary of Agriculture.

There will be no attempt on the part of the Federal Government to interfere with the domestic affairs of the States—all that will be insisted upon is that if the States care to participate, they must participate under the terms of the bill.

The appropriations made by the act are not so large, possibly, as some of the advocates of good roads would desire; but quite as large doubtless as the States would care to make on their own account; and if the plan should work well, the passage of this act will be the first step towards the solution of one of the greatest economic questions of the times, and will lead inevitably to other measures in the future.

## New Legislation Proposed in Kentucky

One of the surest indications of interest in road building in the State of Kentucky is found in the legislation which is being proposed by the General Assembly now in session. Up to the present time seventeen bills have been introduced by both branches of the legislature, and it is worthy of note that no bill thus far introduced tends to do other than strengthen the present road-building laws. It is possible that some of these bills may fail of final passage in the rush and confusion of the closing hours of the session, but it seems safe to say that the more important will become laws and will leave Kentucky in an excellent condition so far as road legislation is concerned.

Among these bills, one of the first in line of importance is the Wide Tire Bill, for lack of which Kentucky has been groaning for a number of years. This law will regulate the width of tire per weight of load, and, briefly stated, proposes to limit the load on each axle, including the weight of the vehicle, to five hundred pounds per inch width of tire for tires two inches in width or less, and for tires in excess of two inches in width, the limit shall not exceed five hundred pounds per inch width of tire for two inches in width, plus four hundred pounds for each additional inch of width. This bill applies to roads which may be designated by the Fiscal Court, and declares that said court must so designate any road upon petition of ten freeholders of the county. Later: This bill failed to pass in the House.

Another bill designed to relieve a situation of local financial embarrassment made apparent by State aid, is the proposed constitutional amendment permitting counties to increase the tax levy from the present limit of fifty cents on the one hundred dollars for county purposes, but not to exceed one dollar on the one hundred dollars for county purposes, any portion of which may be devoted to road improvement. This bill, if passed and affirmed, by a vote of the people at the next general election, will obviate the necessity, in many counties, of voting bond issues for the purpose of building roads under the State-aid plan. It has become very evident of recent years that the low rate of taxation which the constitution permits, will not yield the large mountain counties sufficient revenues to properly patch the mud holes in the many miles of earth roads which they already possess, to say nothing of furnishing funds for the purpose of constructing hard-surfaced roads.

At the last general election, the voters of Kentucky ratified the constitutional amendment permitting the use of convicts on the roads and on the prison farms outside the walls of the State penal institutions, and it has become the duty of this session of the General Assembly to enact a law which will prescribe the rules and regulations for the employment of the convicts for such work. Consequently a bill has been introduced which tends to take care of this situation, the title of which is as follows: "An act providing for the working of prisoners, who are confined in the prisons, on State highways and bridges constructed by the Department of Public Roads; providing for the setting apart of a fund to be used by the Department of Public Roads in building State roads and bridges with convict labor, and to enable said Highway Department to work said prisoners in mining, quarrying, and manufacturing and preparation of material for building roads and bridges; providing aid and assistants to the Commissioner of Public Roads in the construction of State roads with convict labor and otherwise; providing for the assignment of prisoners to do State road work and for their supervision and management while so engaged; providing a method of payment for the roads so constructed out of the State Road Fund, and authorizing the Board of Prison Commissioners to provide means of employment for convicts while not engaged in working on public roads and bridges, and in the manufacturing,

## Phelan & Sullivan Haul Gravel at a Cost of 5c Per Cubic Yard with Plymouth Locomotives

Phelan & Sullivan, contractors of Syracuse, N. Y., built the Syracuse-Bridgeport State highway.

There was a haul of gravel from pits to point of use of 2½ miles —and the haulage problem was liable to knock profits sky-high. But Phelan & Sullivan solved the problem and hauled their gravel at a cost of 5c per cubic yard, which was cheaper than steam or horses ever did.



*From a Photo*

### Here Is What Phelan & Sullivan Say:

"The machine makes ten trips each day with 9½-yard cars, making a total of 270 cubic yards of gravel per day," writes Mr. L. D. Sullivan. "The cost of operation is $13.50 for labor, gasoline and oil, which is, approximately, 5c per cubic yard."

### Plymouth Locomotives Do Wonders In All Sorts of Duties

On construction work—in road building—in mines—in gravel pits—in brickyards—and wherever haulage between two fixed points is a problem, Plymouth Locomotives are working low-cost miracles every day.

**Read Phelan & Sullivan's Story—It's FREE to You.** We have a little folder that gives the record of the two "Plymouths" on this highway job and anyone who has a haulage problem ought ro read this interesting little story. A copy will be sent free for the asking.

**THE J. D. FATE CO.,** 209 RIGGS AVENUE PLYMOUTH, OHIO



# NATIONAL MAP SHOP

MODERN MAPS WASHINGTON COMPILING-DESIGNING
DESIGNED FOR REPRODUCTION DRAWING-PRINTING-ENGRAVING



**Attractive maps talk! If you want YOUR map, plat or diagram to get an AUDIENCE, you can't afford to overlook this point. Tell us what you want and let us give estimates and samples. ROAD MAPS FOR BLUE PRINTS OR LINE CUTS A SPECIALTY**


quarrying, mining, and preparation of road material, providing that the Board of Prison Commissioners may lease farms on which to work convicts, and providing compensation for all prisoners that may work under the supervision of the Board of Prison Commissioners." Later. This bill has passed both branches and is now in the hands of the governor.

Another bill has been introduced which permits State aid to be granted on through routes of more than fifty miles in extent, when the Fiscal Court of the county through which said route runs requests State aid to be applied upon said road. This bill has already been favorably reported by the Senate Committee to which it was referred and will doubtless be passed within the next few days, and will tend to relieve a good deal of dissatisfaction which is being felt in several sections of the State, because at present it seems impossible to defines a portion of some through routes as inter-county seat roads. Later. This bill has passed the Senate.

In the past it has been illegal for a Fiscal Court of Kentucky to appropriate or expend any of the county fund before the levy had been made, and this condition has financially embarassed many counties. To relieve the situation a bill has been introduced permitting the Fiscal Court to anticipate the revenues for the current year, and this, if passed, will doubtless enable them to secure a lower rate of interest on any funds that it may be necessary to borrow.

Some dissatisfaction has arisen in some of the bond-issue counties of the State because the plans originally promoted by those favoring the issuance of bonds were not strictly adhered to when construction work was started. This tended to make the proposition of voting bonds unpopular with the people, and in consequence, a bill has been introduced requiring the Fiscal Court, before submitting a proposition for a bond issue to the voters of the county, to make a definite statement of the plan to be followed after the money has become available, and to stick to the original plan as stated.

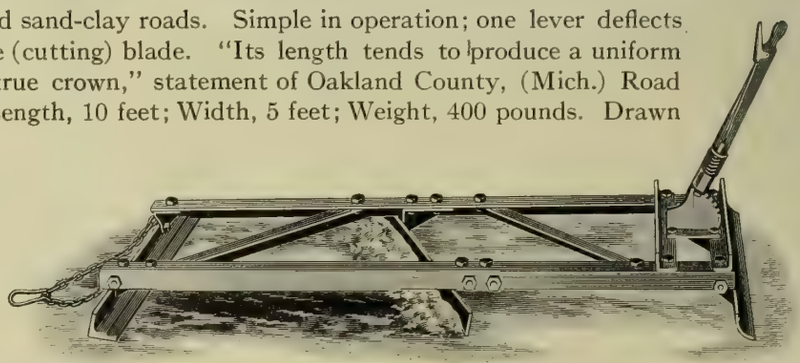
Because of internal strife in the managing of the county affairs, in some instances road work has been blocked for quite a period of time, due to the fact that members of the Fiscal Court would not agree to the desires of other members of the court, and in consequence in more than one county of the State, State aid in 1915 made no progress. To alleviate this situation, a bill has been introduced authorizing the Commissioner of Public Roads, when the Fiscal Court fails to agree, to select the road to be improved, and requiring the court to concur with the commissioner's selection. For the purpose of obtaining the benefits of this act for State-aid work in 1916, this bill has been declared an emergency and will become a law upon its passage and approval by the governor.

Bills have also been introduced compelling property owners to cut weeds and keep ditches open along their property abutting on the public roads, fixing a date at which this work shall be completed, and fixing a penalty for failure to perform such work after notice by the County Road Engineer.

Another bill has been introduced to require railways to construct and maintain adequate crossings, whether grade, overhead, or subgrade.


# THE McCALLUM ROAD PLANE

For the care and maintenance of earth, gravel, and sand-clay roads. Simple in operation; one lever deflects the rear blade, controlling the depth of the middle (cutting) blade. "Its length tends to produce a uniform cutting and filling which leaves a smooth and true crown," statement of Oakland County, (Mich.) Road Commission. Solidly built of steel throughout. Length, 10 feet; Width, 5 feet; Weight, 400 pounds. Drawn by two horses or tractor.



*Write for information regarding 10-day trial offer to*

## ANGUS McCALLUM

*Patentee and Manufacturer*

**21 N. Saginaw St. PONTIAC, MICH.**

*FACE FACTS!*

About the **Hall Interlocking Concrete Culvert** and Other Culverts

**Everlasting**—
No iron rods or hooks to join sections. It's all reinforced concrete—you know what that means.

**Economical**
No cement, sand, gravel, labor, or haulage wasted. This culvert does not mortgage the future; once placed, it becomes a permanent monument.



*This culvert is not a substitute for anything—it is the perfection of engineering design, service and economy.*

*Manufactured and sold by only one reliable engineer or contractor in a county or district under our exclusive license contract.*

**Profitable**—
For the Contractor because it is shop-made, hence eliminates his "idle season."

**Popular**—With the Taxpayer because the road is not blocked during installation and no repairs ever necessary.

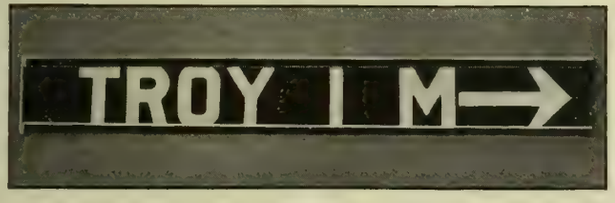
A CULVERT EVERLASTING.
19 feet long, 12 inches diameter being installed in 1½ hours at Greenville, Miss. Two autos and three wagons passed over this structure while work was in progress.

**SCHULZ & HODGSON,** :: :: :: **19 South LaSalle, Chicago**

*THE SOLUTION OF THE SIGN PROBLEM*

# THE INTERCHANGEABLE CROSSROADS DIRECTION SIGN

**Gives any reading desired, for temporary signs: DANGER, SLOW DOWN, BRIDGE OUT, ROAD CLOSED, DETOUR—1 m. S. I m. W., USE THE WHOLE ROAD, Etc. Just the thing for ROAD NAME SIGNS and BRIDGE NUMBERS.**




Interchangeable Sign (Assembled)




Sign (Disassembled Showing Separate Letters and Back Plate)

Notice Top and Bottom Extensions Insuring Perfect Alignment and Proper Spacing Between Letters.

A
Plain
Permanent
Indestructible
Weatherproof
All-Metal
Sign

**Order crossroads direction signs as you would anything else. Just say how many. Ten, fifty or a thousand at a day's notice. Keep a few on hand and put them up as you need them; it takes sixty seconds to permanently assemble a twelve letter sign.**

**THE INTERCHANGEABLE CROSSROADS DIRECTION SIGN conforms to the specifications of the State Highway Department.**

**The Ohio Culvert Pipe Co.,** Tiffin, Ohio, U. S. A.




Sure —It's The

"ACME" (NESTABLE)

Corrugated Anti-Corrosive NO-CO-RO METAL Galvanized Culvert

"I might state that it looks just as good as when it was put in,"—writes Mr. Wade W. Shidler, City Engineer of Alliance, Ohio, referring to the "ACME" (Nestable) Culvert illustrated above.

An excellent record, but not in the least unusual for our "ACME" (Nestable) Corrugated Anti-Corrosive NO-CO-RO METAL (99.90% pure) Culverts.

"ACME'S" are shipped Set-up or knocked-down and nested, just as you prefer.

Have you our Catalog? Yours freely for the asking.

THE CANTON CULVERT & SILO CO.
MANUFACTURERS
CANTON, OHIO, U.S.A.



## The Sunbury Automatic Car Unloader

Highest Efficiency Lowest Operating Cost

Absolutely Automatic on Sand, Screenings, Slag, Stone, Small Coal, or Other Loose Material.

WRITE FOR CATALOGUE.

THE SUNBURY MANUFACTURING CO.
SUNBURY, OHIO

C. G. Milburn, Distributor, 600 Columbus Savings & Trust Bldg., Columbus, Ohio


The Rapid Mixer Company, manufacturers of the well-known Rapid hot mixer, are putting on the market the new Rapid Sand and Stone Dryer. Designed primarily to heat and dry the grit for squeegee coats on bituminous pavements, the machine is adapted to many uses on street work, particularly in small cities.

An oil burner operated by compressed air furnishes the heat to dry the materials. Power to revolve the screen is furnished by a gasoline engine.

The machine is a light, portable, and self-contained dryer. For further information as to weight, capacity, etc., address Rapid Mixer Company, Grand Rapids, Mich.

* * *

We are just in receipt of a new catalogue from the Sterling Motor Truck Company, Milwaukee, Wisconsin, the cover of which catches our attention by showing a large action photograph of the Sterling-Kindling Motor Squeegee, described in the last issue; but in addition to the photograph there are given detailed drawings and specifications of the machine.

We also notice a photograph and description of the special Allen Pressure Road Oiler, mounted on a Sterling two-ton chassis; and further along a Sterling Automatic Dumping Truck for road contractors, and other machines of special use in road and street work.

* * *

Just received a new circular from the New Idea Manufacturing Company, of Elkhart, Indiana. Reminds us to say that if you haven't yet investigated their one-lever dump wagon, it is about time you were doing so. Will only cost you a two-cent stamp, or a post card, if that's handier.

* * *

## New Koehring Low Priced Mixers Put Out on the "Ford" Plan

Two new mixers were on display at the Koehring booth at the recent Chicago Cement Show. These will be built in big volume on the "Ford" plan—fast manufacture of strictly standardized machines in big volume to make a low price possible.

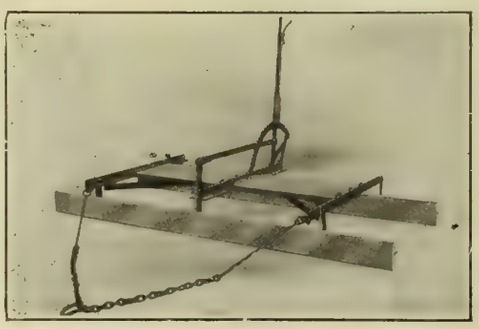
The "Dandie" line is the name given to these new machines. The line consists of construction type mixers built in five and ten cubic foot capacities, and high drum, end loading pavers of ten and twenty cubic foot capacities.

The construction type mixer is a "low-down" machine provided with platform for wheelbarrow charging. If preferred, it is equipped with batch hopper and power loading skip.

The mixing action is the same as on regular Koehring mixers, with the discharge spout extending inside the drum, and in mixing position forming part of the mixing action. To discharge, this chute is reversed.

The trucks are extra strong and the tires wide. All bearings are constructed on the universal principle. Double drum drive gears are cast from special composition metal.

The power loading skip has an automatic knock-out and brake which automatically stops the skip in the charging position and holds it until released.

The AMERICAN Champion Adjustable Road Drag.

## THE AMERICAN CHAMPION ADJUSTABLE ROAD DRAG

It cuts and crushes, levels and smooths the road, all in one operation.

Cuts the cost of dragging right in two.

Made of steel, with hard wood or corrugated iron top, as desired.

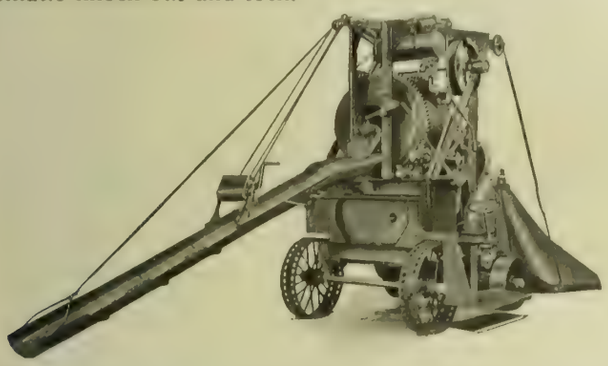
Don't use a crude and out-of-date Road Drag when you can get an AMERICAN Champion for little money.

*You will be interested in our Road Drag Bulletin. It is free.*

THE GOOD ROADS MACHINERY CO. - Kennett Square, Pa.

The Koehring three-way valve automatic measuring tank may be had on these mixers.

On the paver the mixing drum is placed high, which affords a large spouting range and makes possible a steep angled chute. The wide skip accommodates two wheelers at the same time, and, like the construction type machines, is provided with automatic knock-out and lock.



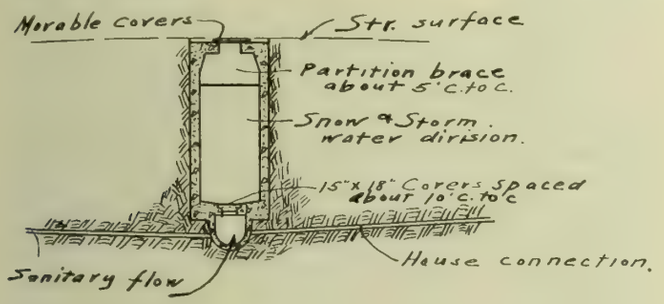
The spout is self-compensating, maintaining the point of discharge at the same distance from the ground regardless of how many sections are in use. The pavers are provided with gasoline or steam power as desired. Power plants are all securely housed.

Special literature has been prepared on the "Dandie" line. Send for booklet E-22 on the low chargers and F-22 on the pavers, to the Koehring Machine Company, Milwaukee, Wis.

* * *

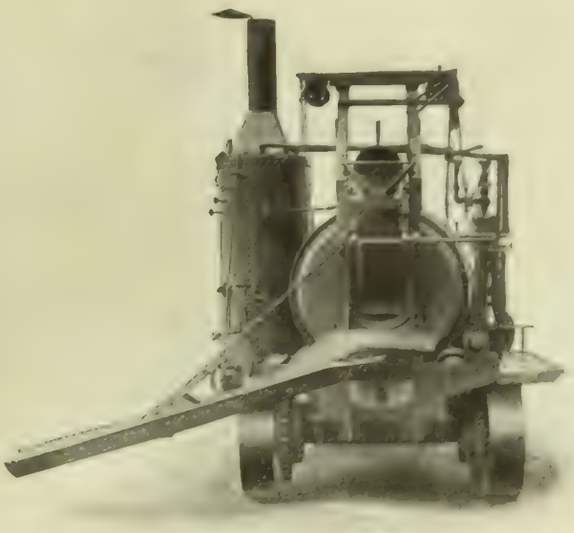
## New Device for Sewering Snow

Much attention was given at the Chicago Cement Show to models of a newly-designed sewer made possible by reinforced concrete and including snow disposal at trifling cost as one of its features. The snow is swept into the sewer and lifting and hauling are avoided. It is possible to convert this sewer from




a combined system to a separate system, or vice versa, without involving any cost or reconstruction.

The construction consists of a longitudinal channel extending to the under side of movable street surface covers to permit of the insertion of snow. In the lower portion of this channel which takes snow and storm water, means are provided for the sanitary flow without danger of the solid matter swept with the snow from coming into contact with the flow.

YOU SHOULD BE POSTED

**There are exclusive advantages in MARSH-CAPRON PAVERS which every contractor should know about. There are three sizes to select from, END OR SIDE LOADERS, the most powerful traction, the easiest operation, profitably used with industrial cars, planking on the sub-grade not necessary, no lost motion, all levers within easy reach. COMPETENT AUTHORITIES SAY "THERE NEVER WAS A BETTER PAVER BUILT."**

*Your name on our free list will bring you paver, mixer, and grouter data.*

**MARSH-CAPRON MFG. CO., 1465 Lumber Exchange, CHICAGO**

Member of the National Association of Mixer Manufacturers.
Our Mixers Rated by the N. A. M. M. Wet Batch Rating.

WANTED

Second-Hand 24" Gauge Locomotive from 5 to 6 tons service weight. Koppel engines preferred. Also dump cars and portable track, 24" gauge. Also want to purchase Second-Hand Locomotives, 9x14 and 10x16, provided they are in good working condition.

Address

A. J. BRADY, Canton, Ohio

SAFETY FIRST

KYROCK

KENTUCKY NATURAL ROCK ASPHALT

THE COMING ROADWAY

The only Asphalt Surface furnishing a Safety tread for Horses and Autos. Why?

*Send for Booklet*

**THE WADSWORTH STONE & PAVING CO. - - Pittsburgh, Pa.**

"HARRIS PAVERS"
Daily Capacity 40,000
THE HARRIS BRICK COMPANY
Main Office CINCINNATI, OHIO
Factory ZANESVILLE, OHIO

"Hydrolene"
Asphalt Products for Road Building are Unsurpassed
Road Binders, Asphaltic Cements, Road Oil
SUN COMPANY
Toledo, Ohio Philadelphia, Pa. Chicago, Ill.

PENNSYLVANIA PORTLAND CEMENT
"For Better Roads and Streets"
PENNSYLVANIA CEMENT COMPANY
30 East 42d Street NEW YORK

CHICAGO PAVING LABORATORY
LESTER KIRSCHBRAUN, Ch. E., Director
Consulting and Testing Engineers
Pavements and Paving Materials
160 N. FIFTH AVE., CHICAGO
Reports, Specifications, Plant, Street and Laboratory Inspection
Asphalts
Tars
Creosote Oils
Road Oils
Binders
Petroleum

A. H. Blanchard
M. Am. Soc. C. E. M. Can. Soc. C. E.
Consulting Highway Engineer
Broadway and 117th Street New York City

and backing it up. Provision is also made for combining the two flows. Used in connection with an inverted roadway crown, catch basins are unnecessary. Substructures are not interfered with, and can be arranged in this construction to avoid much tearing up of the roadway and general disturbances.

It is claimed that the saving on snow disposal soon pays the entire construction cost.

L. Davidson of 309 Broadway, New York City, is the patentee of this system.

* * *

William R. Roy has resigned as Highway Commissioner of Washington on account of ill health. In accordance with the Washington State law, the duties of the office will be performed by Thomas G. Bush, the present assistant commissioner, in the capacity of Acting State Highway Commissioner. Mr. Bush has been active in the business management of the Highway Department for the last two years. He was formerly connected with the cement industry in eastern Washington. Thos. G. Bush is the author of a treatise on "The Improvement of Earth Roads," and articles dealing with public highways, and is well known among road builders in the Northwest.

* * *

## Working Side by Side

It is not often that one sees two paving mixers working G. Bush is the author of a treatise on "The Improvement of considerable length. But such was the case when Colerain Avenue, Cincinnati, Ohio, was paved last summer.



Two Ideal Cincinnatus Tractor Paving Mixers working on the same street.

As shown in the illustration, this street carries a double track car line, leaving a rather narrow roadway on each side between the outer rails and the curbs. As it was necessary to keep street-car traffic moving on both tracks at all times while


JAMES H. MAC DONALD
Consulting Road and Pavement Expert
Chamber of Commerce Bldg., NEW HAVEN, CONN.
State Highway Commissioner of Connecticut nearly eighteen years.
Advice given on all phases of road building and street paving.
Consultations on specifications, materials and methods. Specialty of recommending efficient and economical equipment and plant. Accurate estimates for contractors.

APOLLO-KEYSTONE Galvanized Sheets
Made from KEYSTONE COPPER STEEL—Unequaled
FOR ROADWAY CULVERTS
as well as for Roofing, Siding, Flumes, Tanks, and all forms of exposed sheet metal work. Demand APOLLO-KEYSTONE for your Roadway Culverts. Look for the stencil—it insures greatest durability and resistance to rust. Accept no substitute. Write for our free booklet showing actual service tests.
AMERICAN SHEET AND TIN PLATE COMPANY, - - - General Offices: Frick Bldg., Pittsburgh, Pa.

work was going on, the use of any but a very narrow paving mixer was impossible.

For this reason, Mr. Thomas Evans, the contractor, bought a 7-foot Ideal Cincinnatus Traction Paving Mixer from the Ideal Concrete Machinery Company, Cincinnati, Ohio, which was small and compact enough to use in this narrow space.

After it had been in use for a few weeks, its operation attracted the attention of J. F. Venning, Superintendent of Construction of the Cincinnati Traction Company, who had charge of putting in that portion of the pavement foundation between the street-car rails. Hand-mixing methods had been employed up to this time, but Mr. Venning saw a chance for improvement, so purchased an Ideal paver of exactly the same size and type as the one the paving contractor was using. According to figures compiled by Mr. Venning, the saving effected was as follows:

| Method | Cost per Cu. Yd. | |
|---|---|---|
| Hand mixing | $1.10 | $1.40 |
| Machine mixing | .22 | .40 |
| Saving | $0.88 | $1.00 |

The traction company's machine was brought on to the job on August 18, 1915, and from that time on to February 1, 1916, the two pavers worked down the street within a stone's throw of each other, though never interfering.

* * *

## Sack Balers on Wheels

Several road contractors, stopping at the booth of the Hargrave-Lewis Silo Company, Litchfield, Illinois, to inspect the New Economy Sack Baler, were led to inquire how it could be used by them on road and street work, where the mixer is constantly being moved ahead.

Impressed with this demand, before the Cement Show week was half over Mr. Hargrave had prepared a design for a portable baler and contracted for several hundred sets of wheels



to meet the anticipated demand for such machines, when their manufacture became known.

The accompanying illustration shows the first machine completed. It is rigidly constructed and strong, yet light enough to be moved around by a boy, as the illustration shows.

A sack baler on wheels is something every paving contractor should have. Cement sacks are worth ten cents apiece. A sack baler costs between two hundred and three hundred sacks.

* * *

## New Motor Oilers and Other Motor Machines

"A Better Way" is the name of the first catalogue of the new Municipal Equipment and Construction Company, 111 W. Washington Street, Chicago, Illinois. Described in this attractive folder are three modern motor-driven machines for road and street work, namely, the "Allen" oil distributor, the "Mecco," a similar machine, but internally heated, and the "Sterling-Kindling" motor squeegee.

As noted last month, the "Allen" is a development of the Berrien County, Michigan, machine, described in the Novem-




# What Does a Repeat Order Mean?

Letters and testimonials telling the virtues of different pavers are fine—as far as they go. Sometimes they are based on only one feature or on performance under one set of conditions—then they don't go far enough. But when a man says "send me another" and lays down his hard-earned cash to make sure he'll get it, you *know* his paver has made good in all respects, under all conditions.

Now listen—
**65% of all Foote sales are repeat orders.**

Isn't that some testimonial?

And Foote construction—the result of years' experience—is more or less responsible.

*Ask us.*

**Address the Nearest Agent**

Foote Concrete Machinery Co.,
112 S. LaSalle St., Chicago, Ill.

Wilcox Bros., Inc.,
26 Roosevelt Ave., Binghamton, N. Y.

E. J. McHarg & Co.,
3 Crandell Street, Binghamton, N. Y.

W. C. McAnlis,
Imperial Hotel, Detroit, Mich.

Edward R. Bacon Co.,
51 Minna St., San Francisco, Cal.

Made by Foote Manufacturing Co.
Nunda, N. Y.

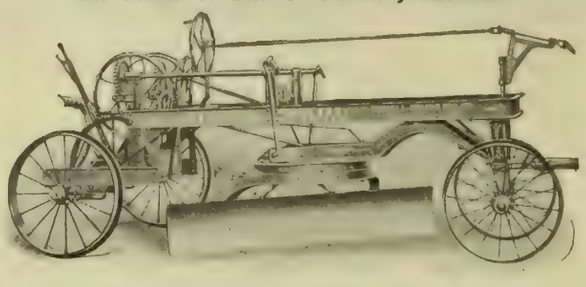
EVERY FOOTE A MIXER

TELL 'EM YOU SAW IT HERE.

Investigate Russell Road Machines

WE MEET YOU HALF WAY IN PROVING ALL WE CLAIM BY OFFERING A FREE TRIAL ON ANY MACHINE

First Get Our Big 112-Page Catalogue And Learn The Details Of Each Of Our Many Machines



The Russell "SPECIAL"
Weight, 3700 lbs., 8 ft. Blade, Reversible

This machine has the widest range of adjustments of any road machine built. It is built for tractor use or for work with 12 horses. In design it is similar to our big "Mogul," but works with more economy on lighter work. Very efficient in hard, stony or stumpy soil where strength is required. Built mostly of steel—nearly all the parts are forged, and very few castings.

RUSSELL GRADER MANUFACTURING CO.
2207-2229 UNIVERSITY AVE., S. E., MINNEAPOLIS, MINN.
Representatives In All Principal Cities

TIGER STEEL BUNKS





These comfortable, sanitary, steel bunks can be set up and taken down without the use of tools or bolts—just like an ordinary bedstead. They are, however, equipped with a patented locking device, which makes a perfectly rigid frame. This insures a quick shift of camps. Gives your men clean, comfortable beds, which means much better work, and better men. Made in single or double decks in a wide range of sizes.

*Write Us for Particulars and Prices.*

Send for booklet giving inside information on good camp equipment.

HAGGARD & MARCUSSON CO., 1119 W. 37th St., Chicago

READY TO ERECT BUILDINGS



Made in sections. Quickly put up and taken down. Unequalled for Tool Houses, Shelter Sheds, etc. Solidly built to stand hard usage. PEERLESS PORTABLE BUILDINGS, composed of Interchangeable Units, are weather, wind, and waterproof. Any sized building to your order. Simply tell us your requirements. Prices right. Freight paid in North Central States.

PEERLESS BUILDINGS CO., 500 E. 40th St., Chicago

ber issue of Better Roads and Streets. The machine is built in all sizes from 600 to 1,200 gallons. The heater covers a large portion of the tank and is lined with asbestos to prevent loss of heat. Kerosene is used for fuel.

A double rotary force pump forces the oil out of the transverse distributor pipes on to the road, the pipes being sectional, covering a width of eight feet. Extensions can be furnished to twelve feet.

The "Mecco" is similar to the Allen in construction and capacities, but is internally heated and has rear control.

The "Sterling-Kindling" street cleaning squeegee was described so completely in the last issue that further mention is unnecessary.

In the last pages of "A Better Way" are shown photographs of some of the large Sterling Motor Trucks in use on road work by contractors. The Municipal Equipment and Construction Company are distributors for these trucks. Every contractor and road and street official should send for a copy of "A Better Way."

* * *

## Up and Down Hill

The accompanying picture is interesting in showing the use of a large paving mixer placing the concrete foundation for a pavement on some heavy grades. It was taken in Dubuque, Iowa, widely known as the "City of Hills," the work having been done last summer by James F. Lee, contractor of Dubuque. In the picture the paver is shown going up a ten per cent. grade. It had completed the foundation in the immediate



foreground, which was down-hill work on about the same slope, and likewise the cross street, also on a fairly heavy grade. The maximum day's work under these conditions was a trifle more than 1,500 square yards of five-inch base.

The paver used by Mr. Lee was of the "Rail Track" type, built by the Marsh-Capron Manufacturing Co., Chicago, Ill.

* * *

## A Few Things the Contractor Might Well Investigate

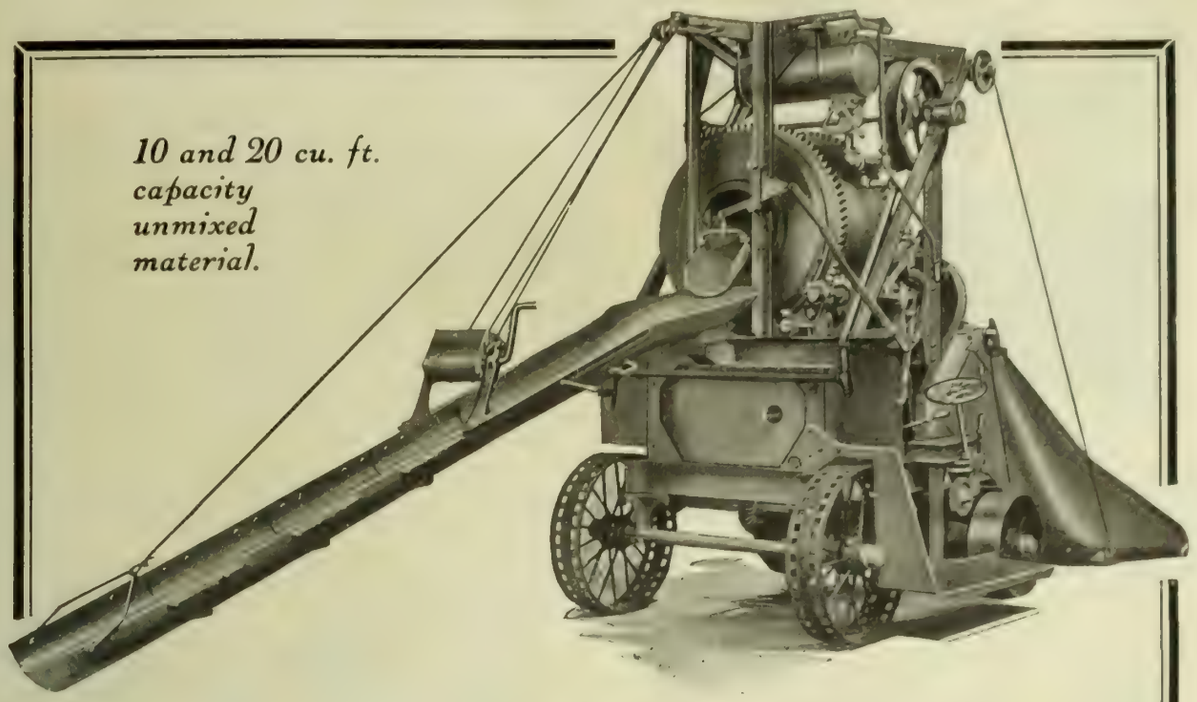
The successful bidder on a concrete paving job presumably will buy a paving mixer providing he does not already own one. He will also buy considerable other equipment, the necessity for which is equally obvious.

It is the intention of this article to point out other investments which the contractor often can profitably make prior to the beginning of his work, but which are not often done, either because he is not familiar with the utility of such equipment, or may never even have heard of it.

How many paving contractors own cement sack balers? They cost about twenty-five dollars apiece, some a few dollars more, some less. Probably not over one per cent. of all the contractors doing pavement work have ever purchased one of these machines.

Why? Because they never thought of it.

In few other kinds of concrete work are more cement sacks lost than in concrete highway construction. This is obvious. The work is constantly moving ahead. When a sack gets



*10 and 20 cu. ft. capacity unmixed material.*

# DANDIE HIGH DRUM PAVER

*—an efficient paving unit, at a price which makes it an extraordinary value.*

THE high drum makes possible the greatly increased spouting range and the steep angle of spout causes fast flow of concrete. Extra wide loading skip affords room for two wheelers at once. Automatic water-measuring tank, and mixing action make it easy to regulate consistency and uniformity of mix to the demands of inspection. Spout is self-compensating. As each end section of the spout is raised, the section next nearest mixer automatically lowers, maintaining point of discharge at uniform distance from ground. Reversible section chutes concrete right up to wheels of the mixer. Forward and reverse traction. Steam and gasoline.

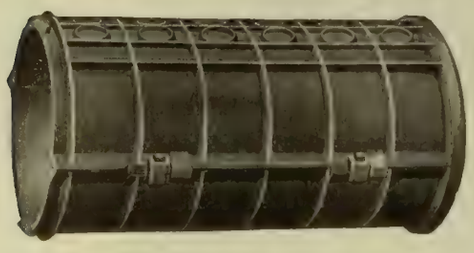
Write for booklet series 22-F. Get full information regarding this record-setting value—ask for booklet 22-F.

## KOEHRING MACHINE COMPANY

MILWAUKEE, WISCONSIN

The "Panama Line"

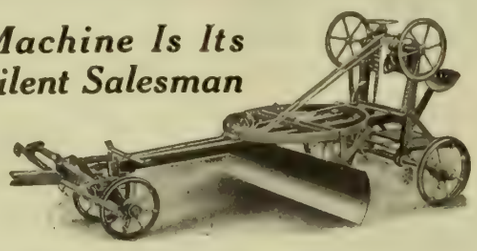
# 7 Exclusive Patented Features Commend This Culvert Pipe



THE **"Panama" Round Culvert Pipe** gives to purchasers seven distinct points of superiority. They combine to give **good facilities in shipping, unusual convenience in installing, strength and protection against the elements when installed, and the very maximum of service.**

These are points which every practical road engineer, official, and contractor considers essential, and he has only to read the complete description of this pipe as given in the "Panama Line" Catalog to immediately note the unusual value and entire practicability of these exclusive features.

## This Machine Is Its Own Silent Salesman



## The Boston Grader

That the Boston Grader is a machine of very exceptional value is convincingly indicated in the fact that wherever introduced, its performance results in many additional orders. It is light enough for two horses and strong enough for four and can be quickly adapted for use as a drag.

We claim the Boston Grader to be the most practical low-priced grader ever made, to be more substantially constructed and to embody more features of approved design than any similar machine in existence. You will want to judge for yourself, however, and consequently will want complete information as given in the "Panama Line" Catalog.

MAIL OR USE FOR MEMORANDUM

The F. B. Zieg Mfg. Co. Fredericktown, Ohio.
Gentlemen:-
Send your catalog as offered in Better Roads and Streets.

Name.....

Address.....

*THE WORD "PANAMA" as applied to road graders, drags and kindred tools stands for paramount quality—is a coveted name, in fact, upon which a high reputation has been built.*

If you do not already have it, you will want to give the "Panama Line" Catalog a permanent place in your library.

THE F. B. ZIEG MFG. COMPANY
*Fredericktown, Ohio*

TELL 'EM YOU SAW IT HERE.


carelessly thrown to one side it always gets left behind. In a few days it is in the ditch, a half-mile behind the mixer.

On a mile of concrete road, fifteen thousand sacks of cement are often used. Each empty sack is worth ten cents. An investment of $1,500. A sack baler would have to save less than two per cent. of all the sacks in order to pay for itself *on every mile of road built.*

And this doesn't take into account the saving of time which would be effected.

The writer of this article has heard of only one road contractor using a sack baler. He put it on wheels, hitched it to the mixer, and it saved him all kinds of money. He is still using it, of course, and probably always will.

CAMP EQUIPMENT.

Some contractors take pride in their camp. Others do not. But how many have studied the camp question to the extent of investigating the merits of steel bunks, for example?

Probably more than have investigated sack balers, but even so, not a great many.

The merits of steel bunks are too numerous to mention—comfort, cleanliness, strength, economy of room, portability, indestructibility, etc. A double-deck steel bunk for four men



**A. L. Courtright, contractor of Hammond, Ind., uses steel bunks exclusively. He generally has four or five macadam road contracts every year.**

costs somewhere in the neighborhood of $7.50. This includes the springs but not the mattresses or bedding. A cost of $1.88 per man, and they will last for years.

Knocked down and set up in a few minutes' time, they are easily transported from one job to the next and incidentally save the contractor much valuable time in getting his camp in shape and work started.

But more important; every contractor must admit that the comfort and cleanliness of the bunk house or tent—whether old, wooden, buggy boxes are provided for sleeping quarters, or the more modern, sanitary, and up-to-date steel bunks—has as great an influence on the work he can get out of the men as his commissary department, which generally receives the greater attention.

This year labor will be scarce and high-priced. Men will quit work at the slightest provocation. See to it that the bunk house does not give this provocation!

And speaking again of portability, how about the bunk house itself, and the cook and tool and supply houses? Some come on wheels, many contractors use tents, and often farmhouses and barns are rented.

These are all good, but there is still another form of house adapted to the camp which we venture hardly any contractors are familiar with, namely, the portable shack, which comes knocked down and all ready to erect. Several companies manufacture such buildings, of both wood and metal. They are of many forms, but at least one recommends itself to the contractor as a time, labor, and money-saving device well worth investigating.

The particular form of portable house referred to is supplied in such form that it can be erected in less than a day's time by one ordinary laborer who is reasonably familiar with the use of a hammer and a wrench. All that is necessary is to bolt the sides and roof together and slip the windows and doors into their prepared places. An asphalt and felt roofing, fur-

nished of the proper size, is nailed on in a couple hours' time if required.

When the job is over the shack is dismantled in equally quick time and moved to the next job.

Certainly equipment of this kind is worth investigating. We may have a few more suggestions to make in the next issue.

* * *

## Lansing Light-Weight Paver

The new Lansing Paver is making its initial bow to the public. Manufacturers of concrete mixers, wheelbarrows, and other contractors' equipment for years, the Lansing Company, Lansing, Michigan, have brought out this season a machine designed especially for those contractors who have paving work to do, but which work does not justify the purchase of one of the big street pavers.

The machine, however, is adapted to street work and is built so compactly that it is claimed it can work without difficulty in a six-foot alley. The drum holds and mixes without slopping, one sack of cement, three cubic feet of sand, and five cubic feet of stone—a 1:3:5 mix.

It propels itself forward or backward at a speed of one and one-half miles an hour. The power is amply taken care of



with a 6 H. P. Novo or Ideal engine, although steam power is furnish to all who prefer it.

All the levers have been conveniently grouped so that one man attends to loading, discharging, and spouting. Samples of this new Lansing light-weight paver are now being shown at the Lansing Company's stores and warehouses throughout the various distributing centers. The factory's large production makes it possible to promise good deliveries.

By writing the Lansing Company, Lansing, Michigan, prospective buyers of light-weight pavers will gladly be directed to the nearest point where one of these pavers can be seen, also an illustrated circular with specifications will be mailed to any interested party.

* * *

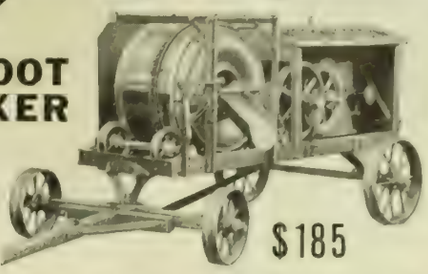
In a very interesting investigation carried on by the Mayor of Philadelphia in 1912 it was shown that the spread between what the farmer received for certain foodstuffs, and what the consumer paid, varied from sixty-seven per cent. to two hundred and sixty-five per cent.; and in dealing with these figures, in an article on the cost of distributing food products which appeared in the Annals of the American Academy of Political and Social Science of last year the former Mayor of Philadelphia referred to, "What these costs mean to the consumer and farmer," in part stated as follows:

"It is difficult for the imagination to grasp just what these costs of distributing farm produce mean in lower prices to farmers and higher prices to consumers. The consumers of New York City pay annually around $645,000,000 for food. This food costs at the terminal $350,000,000. That is to say that the people of New York City are paying about $300,000,000 each year to have their foodstuff taken from the terminal to their kitchens. At a cost of fourteen cents per meal per person for all classes in the city, high and low, rich and poor, Philadelphia citizens are paying $225,000,000 every year for food. Of this amount they are paying about $75,000,000 each year in cartage and delivery costs and in retailers' profits."

Of the $146,000,000 paid annually by the people of New York City for milk, eggs, onions, and potatoes, less than $50,000,000 was received by the men who produced these products. For certain products for which the eastern farmer last summer received $1 the Philadelphia consumer paid $2.35.


PRICE + QUALITY

5-FOOT MIXER



$185

Send For This Book

Learn about the BIGGEST CONCRETE MIXER VALUE OF 1916. Why pay more when you can get a 5-foot "Northwestern" for $185—and on EASY PAYMENTS?

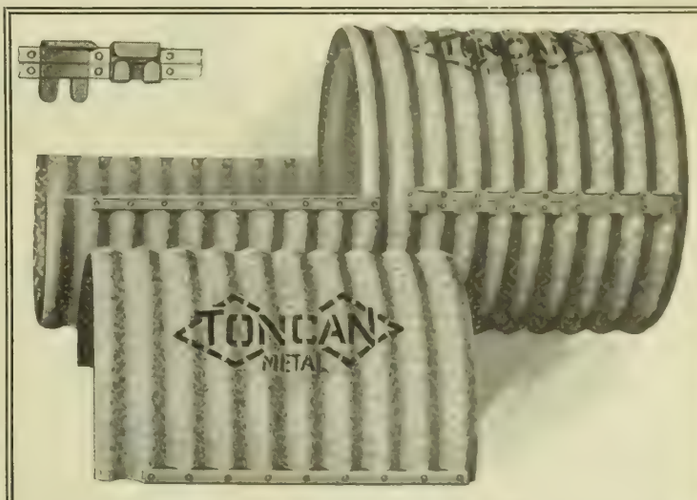
This mixer is built from drum to team pole in our own factory and built RIGHT. It is a well-tried, reliable machine embodying all the best features of mixer construction and we guarantee it to give satisfaction. It has H P [illegible] cooled enegine, standard wheelbarrow hopper, steel housing and team pole with truck of standard wagon gauge. Weight 2,400 lbs. Also made in larger sizes. Ask for Book No. [illegible]



Northwestern Steel & Iron Works
Eau Claire, Wisconsin
Capital Stock, $200,000.00.
Also a complete line of Concrete Tile Forms.

"NORTHWESTERN"






Here's Real Culvert Economy

The real economical culvert is rust-resisting, non-breakable, easy to transport, install and remove, low in cost and maintenance.

Such a culvert is the

BUTT-JOINT NESTABLE CULVERT

Made from

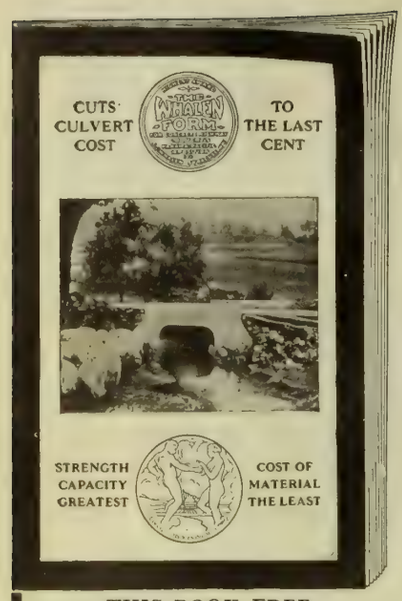
Rust-Resisting TONCAN METAL Anti-Corrosive

SHEETS

Consider carefully the advantages of the Butt-Joint Nestable Toncan Metal Culvert. IT REPRESENTS TRUE ECONOMY.

Write for Catalog

THE BUTT-JOINT NESTABLE CULVERT CO.
826-828 REEDY STREET CINCINNATI, OHIO




# PROOF!

YOU Road Builders are, or should be interested in culvert construction. The most vital question in road building today is, NOT what type of material to use for the surface of the road, or what make of machinery to do the work—but **the one biggest thing in all road construction is, or ought to be, Drainage!** How to get the most water across the road at the least expense and through the most permanent structure—is a question worthy of the best of you.

A NEW BOOK HAS BEEN WRITTEN ON CULVERT CONSTRUCTION. And this book is FREE to interested readers of Better Roads and Streets. The man who compiled the information contained in it probably knows more about this subject than any man in America today. Yet it is all given to you **free for the asking.** The only request is that you mention that you saw this ad in Better Roads and Streets The book does not confine itself to theories—but **is full of facts and figures.** Even if you do not agree with all that is written—tho that is not likely—you will still find the book full of intense human interest. **It will open your eyes**—if it does no more. This is **not** a catalog—it is a free BOOK on the subject of CULVERTS. A cut of the outside front cover is shown above. Now get busy with coupon below.

**THIS BOOK FREE**

SALESMEN WANTED FOR

## THE WHALEN FORM

**401 Vinney Building, Syracuse, New York**

**Use Coupon Below at Once and Get Your Copy of This Book Free Today.**

**Fill out and mail today the Coupon below addressed to The Concrete Form Co., Inc., 401 Vinney Bldg., Syracuse, N. Y.**

*Send me at once postpaid, and with no charge or obligation, a copy of your new Culvert Book*

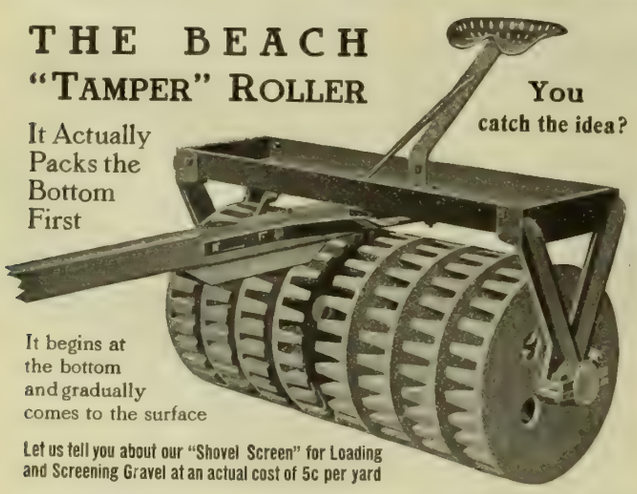
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## THE BEACH "TAMPER" ROLLER

It Actually Packs the Bottom First

You catch the idea?



It begins at the bottom and gradually comes to the surface

Let us tell you about our "Shovel Screen" for Loading and Screening Gravel at an actual cost of 5c per yard

**Beach Mfg. Co., 30 Beach St., Charlotte, Mich.**

## WANTED

**Ten to Twenty-Five Thousand Dollars, to push the manufacture of road machinery. Been in operation for seven years, put out 800 machines last season. If you have money and brains I have a place for both at the top price. If I can't show you 35% on your investment, don't touch it. If you are situated to take advantage of this opportunity write me—but don't write for curiosity, as I am busy.**

**Road Builder care Better Roads and Streets.**


All are interested in cheaper costs of food distribution. The farmer, is, of course, because it means higher prices. The consumer is because that is his only hope of lower prices. "It is mainly in the development of direct shipments to nearby markets that the farmers' returns can be increased and the consumers' prices lowered.

"The cartage of food products by individual farmers from the farm to some market as is now the custom will always be the most expensive method. The time is coming when the motor truck will play an important part in co-operative marketing by farmers. That, however, must wait until proper road facilities exist for the motor truck."

* * *

A. N. Johnson, recently with the Bureau of Municipal Research, New York City, has been tendered and has accepted the position of Consulting Highway Engineer for the Association of American Portland Cement Manufacturers. It is needless to say that Mr. Johnson's wide experience and well-known ability will become a valuable factor in the promotion of concrete roads. Mr. Johnson may properly be called a pioneer in this type of construction, in which he took particular interest while State Highway Engineer of Illinois, which office he held for eight years. At the International Road Congress held in London some years ago, Mr. Johnson presented a paper on the subject of concrete roads. He was among the first to point out the necessity of standardizing practice with reference to efficiency as opposed to indiscriminate and superficial methods.



A. N. JOHNSON

Mr. Johnson's experience in highway construction in general will be of direct service in concentrating his efforts upon a particular type of road. During the past year he has been compiling a digest of the road laws of all States, this work being done for the Rockefeller Foundation. The following is a brief summary of his work: He is a graduate of Harvard University, and in company with Logan Waller Page and A. B. Fletcher, took the first course in highway lectures offered in this country by the University. He is an honorary member of the Association of State Highway Officials; at one time Third Assistant Engineer, Massachusetts Highway Department; State Highway Engineer of Maryland for seven years, and for a period of one year Chief Engineer U. S. Office of Public Roads.

* * *

## Ten New Features on the New Smith-Chicago Paver

Ten new and exclusive features are combined in the latest Smith-Chicago paving mixer shown for the first time at the Cement Show in Chicago last month.




# 100 YEARS ON DUTY

Just imagine standing out in the rain, sleet, snow, cold and sunshine for 100 years—just think of having stones and bricks thrown at you now and then for amusement.

It takes a strong constitution to withstand such abuse and remain on duty every minute of the time for 100 years—but



# INDESTRUCTIBLE SIGNS

**"The Signs That Outlive Father Time"**

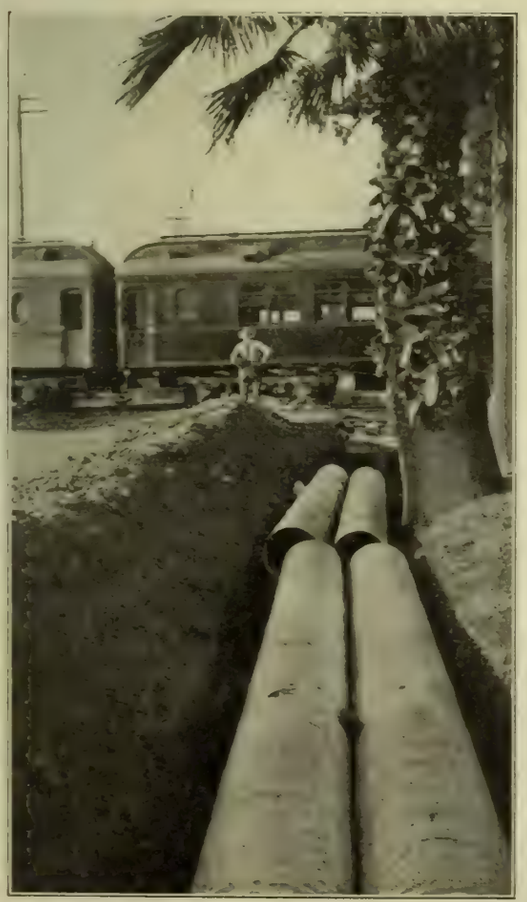



Are built to stand all this treatment. The fact is—tests have proven them practically indestructible.

*Send for Our Booklet and Testimonials.*

## THE INDESTRUCTIBLE SIGN COMPANY

**61½ Prescott Avenue, Columbus, Ohio**



# For Highway and Railway Drainage

*Reliability, Long Service and Real Economy are embodied in*

## "ARMCO" IRON CULVERTS

They are easily transported and installed. Their corrugated form and overlapping joints confer ample strength together with a *flexibility* which makes them to a great extent immune from damage by frosts, floods or settling foundations.

Their material, by virtue of its remarkable purity and evenness, ensures a lifetime of service.

AMERICAN ARMCO INGOT IRON
"ARMCO" IRON
the product of The American Rolling Mill Co. is the standard for Purity and Rust-Resistance

For full information as to Rust-Resisting "Armco" (American Ingot) Iron Culverts, Flumes, Sheets, Roofing and Formed Products, write to

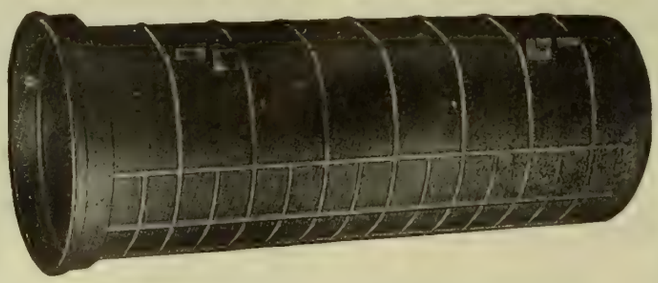
## ARMCO IRON CULVERT MFRS. ASSOCIATION

CINCINNATI, - OHIO

# SAVE TIME—SAVE MONEY

USE THE

## Burch Expansion Cast Iron Culvert Pipe



8 to 48 inches diameter, 3 and 4 ft. lengths. Half sections which lock with lugs.

Provides for expansion and contraction. Easy to handle and lay in ditch. Requires less excavation. Strong and durable. Send for Catalog "F" giving full description of complete line.

## THE BURCH PLOW WORKS CO.

CRESTLINE, OHIO



## Kerosene Power Cheapest for Road Work



How much more money would you make for yourself or for your community if you found a way to cut 25 per cent. off your present cost of grading roads? If you are still using horse or mule power, we can show you a way to save even more than that. If you are using a gasoline tractor, we can still show you how to make a profitable saving.

Every dollar you cut the cost of road grading is a dollar added to your net profit. We can put you in touch with one man who says he cut the cost of road grading in Louisiana from $26.00 PER MILE with mule power to $4.50 PER MILE with MOGUL kerosene tractor power. His figures are in the official records of his parish.

That is probably an extreme case, but the fact that so large a saving as this could be made, is interesting. It suggests that possibly your costs are higher than they need be. Perhaps a little investigation would pay. Would you like to see some of the figures we have collected—some of the savings we have helped other contractors and road builders to make by changing over to MOGUL or TITAN kerosene tractor power? They'll cost nothing but a two cent stamp and a little time. Write for them.

## International Harvester Company of America

(Incorporated)

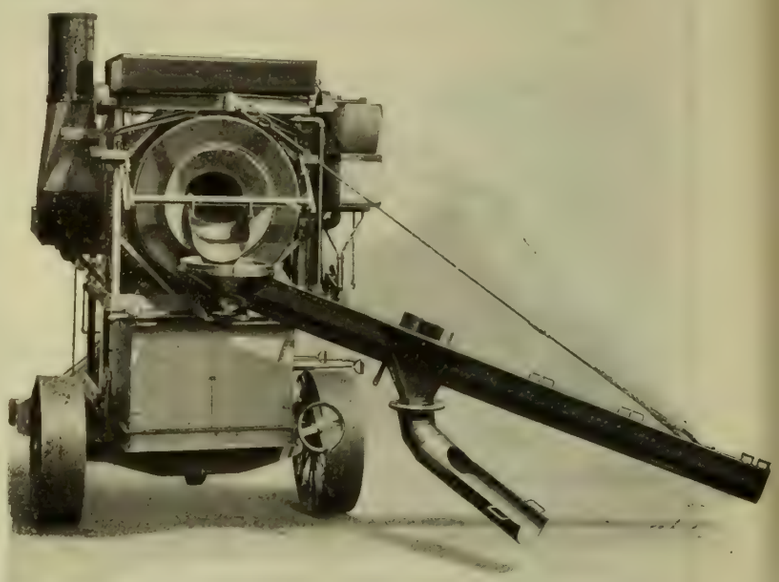
152 Harvester Building CHICAGO, U. S. A.


TELL 'EM YOU SAW IT HERE.

The T. L. Smith Company, Milwaukee, Wisconsin, has been working on the design of this machine for the past two years, and feels confident that it will meet with a most favorable reception among road builders.

A few of the ten new features will be mentioned briefly. Most prominent is the device for accurately weighing the amount of water used in each batch. A simple and accurate lever scale performs this function, it being so arranged that the measuring weight can be locked or sealed at a certain notch on the beam, thereby assuring that exactly the same weight of water will automatically be discharged into the drum with each skip load of materials. An auxiliary water storage tank holds several charges for the weighing tank.

Another important feature is the long, steep-angled chute. A good idea of the design of this chute may be gained from the illustration. It is permanently fixed at an angle of twenty degrees with the horizontal, and is fourteen feet long with two intermediate openings in addition to an auxiliary swivel chute, so that a wide area may be covered.



The design of the skip has received careful attention. It is wide enough for three wheelbarrows to be dumped simultaneously. A catalogue just off the press will tell of the other seven features of the new machine.

It is this machine which was used by Committee VIII. of the National Conference on Concrete Road Building in making their tests on mixing and placing, as described in the March issue of this magazine.

* * *

## The Maintenance and Repair of New York State Highways

(*Continued from page* 5.)

cement when used with sand in mortar. A surplus of sand weakens the cementing qualities of the cement. The same results are obtained by using a surplus quantity of sand to cover the application sufficiently to eliminate the disagreeable condition of the freshly-treated pavement. Where the pavement is not open, requiring a filler for the interstices, and where previous treatments have been given, better results will be obtained where no cover is used, but a freshly-treated surface with no cover is dangerous to fast-moving vehicles, and such treatment is seldom resorted to in the country districts.

While the best results with surface treatments are obtained with a semi-liquid, bituminous product and a minimum amount of cover, the disagreeable features of this treatment from a traffic standpoint have been given serious consideration, and changes have been made in the specifications for surface treatments, which, it is hoped, will materially reduce the period during which the treated surface is objectionable from a traffic standpoint.

The light surface treatment with bituminous material and cover does not appear to be suited to pavements where horse-drawn, iron-tired traffic largely predominates. The iron-tired traffic appears to grind the bituminous material with the min-

eral aggregate and keep the surface roughened and loosened, allowing the volatile oils to more readily evaporate. The bituminous material then loses its adhesive qualities and is ultimately ground to dust and is washed or blown away.

The bituminous mat tends to make the surface waterproof, and as the moisture in the macadam leaches away through the foundation, and not being renewed from the surface, the so-called water-bound macadam is no longer water-bound, but is simply dust-bound and is ready to be loosened by traffic in any spot where the bituminous surface mat is worn through, making it necessary to either provide a heavy mat or to be constantly patching the areas where the mat has worn through. The tendency is, therefore, with the water-bound type to give a general treatment more often than should be necessary, which results in the building up of a heavy mat which creeps and displaces under traffic in hot weather, so that it is then necessary to remove the entire mat and start over with the light surface treatments.

With the bituminous-bound macadam, this precaution is not as necessary. While the bituminous surface sheds off the surface water and the macadam dries out, the individual fragments are bound together with a bituminous material and are not susceptible to the loosening effect of traffic as they are in the dried-out, water-bound type. The result is that a much thinner bituminous surface can be maintained without constant patching, which results in less frequent treatments being required, and the expense of maintenance of the surface by light bituminous treatments on bituminous-bound macadam roads is not much over half of that for water-bound roads.

The bituminous macadam, however, being of a more plastic nature, is more easily displaced by swift-moving traffic, resulting in transverse waves developing in the body of the macadam, and are not as pleasing to ride over as the more rigid, water-bound road.

In conclusion, I want particularly to call your attention to the advisability of having the maintenance appropriation available at the earliest possible date in order that contracts may be advertised, awarded, and the work started early in the spring. This can be better appreciated when it is realized that it requires at least two months from the date of an advertisement to cover the advertising period, the time required for preparation and the execution of the contract and the contractor to get his labor and equipment on the roads ready to commence operations.

It is highly desirable that all maintenance and repair work should be completed early in the season before the vacation period with its heavy touring traffic, and in order that this may be accomplished, the funds therefor should be available early, and in any event, not later than March first of each year.

It also seems pertinent at this time to call attention to the difficulties of that provision of Section 23 of the New York State Highway Law, which requires that in the fall, at the close of a season's work, an estimate shall be prepared of the nature and the cost of the maintenance, repair, and reconstruction required for the following year in detail for each section of highway. At the close of a season's maintenance, the highways should all be in good condition, excepting such as are worn out and require reconstruction. About one-third of each appropriation is expended for resurfacing and reconstruction, and the remaining two-thirds is expended for maintenance and repairs. The winter season in New York State climate is responsible for a large part of the repairs, and determines to a large extent the expenditure that will be necessary for maintenance during the following year.

Owing to the uncertainty of the conditions that will prevail during the winter season, it is impossible to make a detailed estimate for each highway in November that would be more than fifty per cent. applicable to the next season's requirements.

In order to obtain the most efficient results and insure an economical expenditure of the funds, all appropriations should be as elastic as possible, or if some restriction is necessary to insure a proper distribution of the funds, the total mileage of improved highways in each county should be the smallest unit to be used in the restriction of the expenditure of the appropriation, and the appropriation for such a unit should be a blanket amount, available for all purposes of maintenance and repair within the county, and leave the final determination of the





## No Joints to Pour

Think of the economy in time and labor, the satisfaction of having no spacing strips to remove, no tar kettle to heat and no *come backs*. All the work in front of the gang all the time!

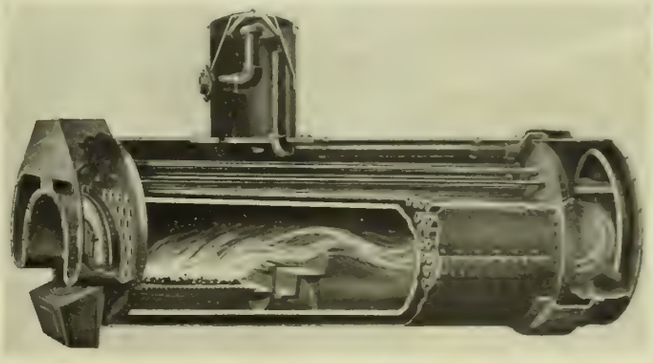
ELASTITE is a scientific expansion joint of high-grade asphalt compound with faces of special asphalt felt. It comes to the job in sections of any required dimensions. It makes a perfect bond with the grout or concrete and expands and contracts uniformly with the structure.

Contractors who have used miles of ELASTITE in streets and bridges have found it most economical. They say that it is a life preserver for the man who does work under the provisions of a maintenance bond.

*For free sample, specifications and literature, address*

**THE PHILIP CAREY COMPANY**

**14 Wayne Avenue, Lockland** **Cincinnati, Ohio**



Sectional View of Boiler.

## Here's Why Huber Rollers Have POWER TO SPARE!

Lots of power; that's one of the things you MUST have in the Roller you buy. And in the "New Huber" you GET it—for the reason that, as this picture shows, "New Huber" Return-Flue Boilers are built to make use of every possible bit of heat. The construction is simplicity itself, without staybolts to rust through and cause leaks.

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details of the work necessary for each highway until the effect of the deterioration during the winter season may be observed.

Appropriations must of necessity be based on estimates made in advance, but such estimates other than for reconstruction should be based on past experiences on the cost of maintenance and repair of as large a mileage as possible of each of the different types of pavement, and no endeavor should be made to detail the nature and cost of the work as to each individual highway.

The larger the mileage that is treated as a unit in the preparation of an estimate based on past experience, the closer will the total of such estimate agree with the actual requirements of the entire mileage.

* * *

## A Glutrin Bound Macadam Road

(*Continued from page 7.*)

A glutrin macadam, properly constructed and maintained comes nearer fulfilling the ideal conditions for a street or highway than any other type. It is comparatively quiet. It has low tractive resistance. The first cost is low. It is economic to maintain. It is easy to construct and repair. It is not affected by frost, rain, or wind. It affords a good foothold for horses and is not displaced by heavy loads or auto traffic. It is practically dustless and is easily cleaned. It radiates but little heat. It is pleasing to the eye and adapted to every grade. It satisfies the requirements necessary to make a road perfect from an engineering and practical standpoint.

* * *

## Thirteenth Annual Convention of the American Road Builders' Association

(*Continued from page* 10.)

subject, in fine shape, and brought out some points that have been given only too little consideration. There was but short discussion following the reading of the paper, those entering into it having been Herbery Spencer, of the Standard Oil Company of New York, Charles W. Dill, and R. H. Gillespie. The session was then adjourned.

There was no regular session in the afternoon, but a business meeting of the American Road Builders' Association was held, at which Colonel Stevens presided. The formal reading of the minutes was dispensed with, and the principal business was the report of the Committee on Resolutions, presented by Chairman George W. Tillson.

The concluding business was the appointment of the Nominating Committee for 1916, the following members being named by H. W. Durham and unanimously appointed: George W. Tillson, New York, Chairman; C. H. Howes, of Massachusetts; George H. Biles, of Pennsylvania; Robert A. Meeker, of New Jersey; R. L. Morrison, of Texas; M. B. Crump, of Kentucky, and W. A. McLean, of Ontario, Canada.

The Chamber of Commerce of Pittsburgh had arranged an automobile ride for the afternoon, and about thirty machines were provided, which proved ample for the number that desired to take the trip over the streets and boulevards of Pittsburgh, and to see the many points of interest.

The final session was held on Friday morning, when three papers were presented. The first of these was on "The Du-Pont Road," by Charles M. Upham, Chief Engineer of the road, and described in detail work and difficulties incident to the construction of that concrete thoroughfare, which, when completed, will extend throughout the entire length of the State of Delaware. There was another long discussion following the reading of the paper.

The second paper was that of Norman S. Sprague, Chief Engineer of the Bureau of Engineering of the city of Pittsburgh, which had not been read on Tuesday, owing to the enforced absence of the author. There was no discussion. The title of the paper was, "The Control of Openings in Pavements."

The final paper was, "The Columbia Highway," prepared by Henry L. Bowlby, formerly State Highway Engineer of Oregon, and who built the greater part of the completed sections of this wonderful highway. In the absence of Mr. Bowlby, the paper was read by Lloyd McIntyre. As there was no discussion, the meeting was formally closed by the chairman.

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# BETTER ROADS AND STREETS



MAY, 1916.

Garford



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# Better Roads and Streets

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## The Macadam Road System of Franklin County, Ohio

By George D. Steele

OHIO, as is probably well known, is a State that is exceptionally rich in materials in every-day use in road construction; but she is particularly rich in limestone deposits, the stone that is admirably adapted to the construction of highways of moderate cost, and of a type that can be, under proper methods, maintained at moderate maintenance costs.

Cuyahoga County, Ohio, has for years been expending vast sums of money in the construction of an elaborate system of the most expensive of all types of highways; but the taxpayers of Cuyahoga County have come to realize that large sums of money are now necessary to maintain and repair, and in some cases to actually reconstruct, the roads which they have been building.

Wayne County, Michigan, has for years been building up a system of roads which has cost millions of dollars. Several years ago, it was stated that the maintenance costs on Wayne County roads was five dollars per mile per year. Detailed costs have never been given in such shape that actual costs could be derived from the annual reports of Wayne County, but by figuring them out as nearly as possible from the reports, it can easily be seen that they are many times this amount; but even this is not excessive, as we all know that there must be maintenance and repair on any type of road that is built, or which probably ever will be built.

Franklin County, Ohio, of which Columbus is the county seat, has been watching the action of traffic on the large mileage of brick roads throughout the State of Ohio, and, with a trifle over a thousand miles of highway within the county, decided that the type of road that should be built should be that which would permit of the improvement of the system in the shortest possible time with a hard-surfaced type that would, with proper maintenance, carry the traffic—and this traffic is not light, by any means. The County Commissioners, after thorough investigation, therefore turned to the macadam type of road as the best and most economical in the end, and the type which would permit of improving the roads of the county in the shortest possible time with the funds which were to be available.

They had been watching with great interest the construction of many miles of main market roads and inter-county highways by the previous administration of the State Highway Department, and, after carefully considering the matter from all angles, decided that the construction of a county highway system of macadam would be by far the most economical in the long run. In this they seem to have been correct, just as have been Wood and Lucas counties, Ohio, which have also built up fine county systems of macadam, and of which we shall, in subsequent articles, give similar details to those given in this article and which concern only Franklin County.

All of the work that has been done in the improvement of the Franklin County road system has been within the past six years. The first few years, when the first work was being done, there was a considerable mileage of gravel or gravel-macadam constructed, and most of this type of roadway has been giving very good satisfaction at comparatively low costs. In 1914 and 1915, however, it was seen what benefits the improved road system was working for the county, and road work was carried on on a much larger scale. Under the system in vogue in Franklin County, bonds are issued for the individual road to be improved, and the money thus raised never covers more than the actual road for which they are issued. As soon as the bonds are sold, the contract for the improvement is let. On inter-county highway construction, under the laws of Ohio, the State and the county each furnish fifty per cent. of the total cost of the improvement.

In 1914, the State of Ohio contributed $92,000, and in 1915 the sum of $35,000, for the construction of inter-county highways, a total of $127,000 in two years. During the same period, the county expended $851,000 on her highway system, $334,000 in 1914, and $517,000 in 1915. In the past two years, therefore, there has been expended in Franklin County, $978,000 in the construction of country roads.

It will be seen from this that Franklin County has an investment of considerably more than a million dollars in her road system, as several hundred thousand dollars were expended prior to 1914. There are, in this system, 1,001.4 miles of highway, of which but 301.7 miles have not yet been improved with a hard surface. The improved roads consist of 354.0 miles of macadam, 301.8 miles of gravel, 6.8 miles of brick, and 2.3 miles of concrete roadways. In addition to the 354.0 miles of macadam, there are also 34.8 miles of asphalt and tar-bound macadam, making a total of 388.8 miles of roads of the macadam type. This is about 38.9 per cent. of the total road mileage, and about 55.6 per cent. of the total improved or hard-surfaced mileage of the county.

Some interesting official figures regarding construction of the two types of roads built in the county in 1915, have been secured, and are presented herewith. Last year's construction work consisted of seventy miles of macadam and three and one-half miles of brick, the latter laid on a concrete base and constructed strictly in accordance with the specifications of the National Paving Brick Manufacturers' Association. The macadam pavement was all sixteen feet in width and nine inches thick, laid in two courses. The bottom course was five inches and the top four inches. All of the seventy-three and one-half miles were built under contract.

The contract price for the macadam, including all grading and drainage, was $6,500 per mile for the sixteen-foot roadway, or at the rate of $8,125 for a twenty-foot roadway. The contract price for the brick roadway was $21,000 for the same width. It will be seen from these figures that about two and one-half miles of the macadam roadway could have been built for the price that was paid for one mile of brick, the figures in both cases including all drainage and grading costs. Therefore, about nine miles of hard-surfaced macadam roadway could have been built for the same price that was paid for but three and one-half miles of brick.

Looking at it from the financial standpoint, basing the interest on money at six per cent., we find a great difference in favor of the macadam roadway. Based on the average cost of $6,500 per mile of sixteen-foot roadway for the macadam type, the annual interest amounts to $390 on the original investment, or it amounts to $487.50 per year based on a roadway twenty feet wide, the width of the brick pavement. The interest at the same rate on the $21,000 per mile investment for the brick pavement twenty feet wide, is $1,260 per year. Now let us justly consider what Franklin County would pay in ten years for each of these two types of pavement. It will be found that the figures will be about as follows:

At simple interest only, the interest on the cost of the twenty-foot macadam roadway at six per cent. would be $4,875, and allowing $250 per year for maintenance, which is ample to keep the road in perfect condition under the patrol system, the charge for maintenance in ten years would be $2,500. As the cost of the twenty-foot road, including all grading and drainage, was at the rate of $8,125, the total cost of the macadam road twenty-feet wire at the end of ten years would be $15,500.

Now let us take similar costs on the brick road, the original cost of which averaged $21,000. The interest on the investment would amount in ten years, at simple interest, to $12,600

at six per cent., and, putting the maintenance for the ten years at the ridiculously low figure of $50 per year, the total to be expended for maintenance would be $500. These figures added to the original $21,000, which a mile of the road cost, would make the road cost Franklin County $34,100 in ten years.

We find, from these calculations, that the macadam roads being built by Franklin County should cost them $15,500 per mile for twenty feet of width in ten years, while the brick roads should cost, for the same width, $34,100 at the end of the same time. This shows a difference in favor of the macadam of $18,000, or considerably more than will be required to build and maintain a road of the macadam type for ten years. Should the macadam road require resurfacing, which would hardly cost over $4,000 per mile at the very outside, we still have a balance of $14,600 in favor of the macadam road at the end of the ten-year period. And this is the way that the commissioners of Franklin County are looking at the problem incidental to the construction of their road system.

The County Commissioners of Franklin County will build, this year, ninety-six additional miles of macadam roadway, and may possibly build seven miles of brick, although this latter is considered doubtful, as they would prefer adding twenty-four miles of additional macadam for the same expenditure. There will also be built in the county four miles of tar-macadam and one and one-half miles of brick under State supervision on inter-county highways, thereby making the 1916 construction program 108.5 miles, of which 100.5 is certain to be macadam. This work will all be done under contract, while all repair work done in the county is by the county



THOMAS E. HUMPHREYS
County Commissioner

forces, details of which work will be given in the latter part of this article.

The county is gaining such prominence through the excellent macadam roads that have been built that the methods and specifications will be of more than ordinary interest to other counties, as well as townships and municipalities, which are interested in a modern and up-to-date type of construction at a moderate initial cost and moderate maintenance and repair costs; so we are presenting the Franklin County specifications herewith in detail.

### TWO-LAYER WATER-BOUND MACADAM

*Hand Level, Straight-edge, and Cubical Blocks.*—The contractor shall provide a hand level and a mason's straight-edge of a length sufficient, when placed at right angles across the road, to rest upon the sideboards; also sufficient four-inch and five-inch cubical blocks necessary to obtain the proper thickness of the macadam in the center of the roadway. The straight-edge and the hand level shall at all times be used upon the sideboards ahead of where the stone is being dumped, so that the proper crown will be obtained; and if any deficiency is found in the subgrade, same shall be remedied by the contractor by adding or removing dirt, then thoroughly rolling to the satisfaction of the engineer or inspector, or by making up said deficiency with stone or gravel, which shall be at the contractor's expense.

*Size and Quality of Material.*—No material shall be placed upon the subgrade until the same has been accepted by the engineer. The macadam shall be constructed of two principal layers of crushed limestone or washed, crushed gravel, or both, either of which shall be screened and uniformly graded and conform to the following sizes:

Crushed limestone shall pass through a four-inch opening and be retained on a two and one-half inch opening. Washed, crushed gravel shall pass through a two and one-half inch opening, and be retained on a one and one-half inch opening. The crushed limestone shall be of good, uniform texture, and of cubical shape with fracture faces, and free from rotten, flat, or inferior stone. It shall be well screened and shall be



RICHARD SINCLAIR
County Commissioner

free from injurious matter of all kinds. The washed, crushed gravel shall be of good, uniform texture, and free from rotten, flat, or inferior stone. It shall be well screened and free from injurious matter of all kinds.

The various sizes of crushed limestone or washed, crushed gravel, when spread upon the road, shall be uniformly mixed to the satisfaction of the engineer and inspector before any screenings are spread.

*Spiking, Scarifying, and Harrowing.*—If at any time any portion of the macadam roadway, either first or second layer, is not satisfactory to the engineer and commissioners, the contractor shall spike or scarify the same, then harrow and add additional stone and screenings, and water-bind the same to their satisfaction.

The macadam roadway shall be paid for by the square yard in place, complete, according to the plans and specifications.

*First Layer.*—The first layer shall consist of macadam as specified. The quality of the crushed limestone or the washed, crushed gravel shall be approved by the engineer and commissioners. On the surface of the compacted subgrade shall be placed sideboards five inches high and..... feet apart, together with a five-inch cubical block in the center. The material shall be spread to the full thickness of the boards and



LEVI E. DOUGLASS
County Commissioner

the blocks. Before the sideboards are removed, a dirt berm shall be placed against the same. This berm and layer of stone shall be thoroughly rolled not less than eighteen inches out with a self-propelled road roller weighing not less than ten tons. No rolling of this layer will be permitted when the subgrade is too wet, the engineer or the inspector being the judge as to the condition of the subgrade at all times. The roller shall be run along the berm and edge of the stone, backward and forward, several times on each side, before rolling the center.

Before putting on the screenings, the bottom course shall be rolled until the stone does not creep or weave ahead of the roller. Immediately after this layer is rolled until the stone ceases to weave or creep in front of the roller, the screenings shall be spread. The surface of this first layer shall be true to line and grade, and shall be thoroughly compacted and free from wagon tracks and ruts before the screenings are spread. All irregularities and depressions which develop in this first layer shall be made up with stone, and at the contractor's expense.



JOHN PEAKE
County Surveyor

*First Layer Binder.*—A layer of screenings, all of which will pass through a one-half inch ring, together with a sufficient proportion of dust of fracture, shall be applied. All screenings shall be dumped in piles along the side of the road, outside the line of macadam, and said screenings shall be delivered in advance of the crushed stone for the course in which they are to be used, as no hauling shall be done on stone that is not water-bound.

The screenings shall be applied in such quantities as will fill all voids in the lower course. Care must be taken not to exceed this amount of screenings. This binder layer shall then be thoroughly rolled dry, then wet and rerolled, adding the necessary screenings, until the whole is thoroughly bonded to the satisfaction of the engineer. By wet is meant thoroughly saturated, and the contractor is required to provide water in sufficient quantities to thoroughly saturate the road, so as not to cause delay in the construction of the same.

*Second Layer.*—The contractor shall at all times, during the construction of the second layer, maintain the first layer by keeping the same thoroughly bonded, free from ruts, ravels, etc., to the satisfaction of the engineer or inspector.

The second layer, or wearing course, shall consist of macadam as specified. Upon the completed lower course shall be



CURTIS C. LATTIMER
Deputy County Surveyor

placed sideboards four inches high and.....feet apart, together with a four-inch cubical block in the center, between which a uniform layer of material shall be spread. Before the sideboards are removed, a dirt berm shall be constructed four inches thick against the same. After the removal of the sideboards, the material which has been spread upon the completed lower course shall be harrowed until a uniform and even surface, satisfactory to the engineer or inspector, has been obtained. This layer of stone and berm shall then be thoroughly rolled not less than three feet out by running the roller backward and forward several times on each side before rolling the center, and this rolling shall continue until the stone does not creep or weave ahead of the roller. All irregularities and depressions which occur in this second layer shall be made up with limestone or washed, crushed gravel, at the contractor's expense.

In finishing any portion of this course, the work shall be carried on uninterruptedly until completed, according to these specifications.

*Second Layer Binder*—Immediately after the surface of the second layer is true to line and grade, and rolled until the stone ceases to weave or creep in front of the roller, it shall be covered with a coating of screenings spread on dry and rolled and swept in. The screenings shall be free from dirt and shall pass through a one-half inch ring, together with a sufficient proportion of dust of fraction. The spreading, sweeping, and rolling of the screenings shall be continued without delay until no more will go in dry. Immediately afterwards, the road shall be thoroughly sprinkled until saturated, the sprinkler being followed by the roller. More screenings shall be added without delay, if necessary, and the sweeping, rolling, and sprinkling shall continue until a grout has been formed that shall fill all the voids, and shall form a wave before the wheels of the roller. The road shall be puddled as many times as may be necessary to secure results satisfactory to the engineer. After the wave of grout has been produced over the whole section of the road, this portion of the road shall be left to dry, and thereafter shall be thoroughly sprinkled and rolled as often as the engineer shall deem necessary.



WALTER BRAUN
Bridge Engineer

*Entrances.*—Private entrances shall be constructed in one layer. The macadam shall be six inches thick and eight feet wide, uniformly spread and screened. All entrances shall be curved to meet the roadway proper, and constructed to the satisfaction of the engineer.

Inasmuch as Franklin County is applying surface treatment to a large part of the water-bound macadam after it has been used through a winter, the methods of applying this treatment will be of interest, and are given herewith in detail.

### BITUMINOUS-SURFACED MACADAM

*Condition of Macadam Surface.*—Where a bituminous surface treatment is to be applied, the contractor shall clean the macadam surface by the use of hand brooms, or by the use of mechanical scrapers and sweepers of approved type, or both, so as to completely uncover and clean, but not dislodge, the embedded stones comprising the macadam. On a new water-bound macadam road, the sweeping shall be continued until the voids are exposed in the surface to a depth of about one-half inch. In case of an old water-bound macadam road, the voids shall be exposed as well as may be with a reasonable amount of sweeping. In the case of an old bituminous road, any surplus matted bitumen, not definitely bonded to the surface, shall be scraped therefrom. The sweeping shall continue until the surface is free from all mud, dust, dirt, and other loose material. Material so collected shall be removed or deposited in such manner as not to be detrimental to the road or cause an unsightly appearance. The cost of cleaning shall be included in the price bid for bituminous surface treatment.

*Method of Applying the Bitumen.*—After the surface has been cleaned as described above, and when in a warm, dry condition, the bitumen, heated to a temperature that will cause it to flow readily and that will give the best results in preserving the surface, shall be uniformly applied to it by means of a pressure distributor or by approved hand-sprinkling pots in the amount of..... gallon per square yard unless otherwise specified in the estimate. If necessary, the bituminous material shall be broomed evenly over the surface before the screenings are added. The bituminous material shall not be put on the pavement at such a rate as will cause it to flow off.

*Grit.*—The bituminous material, applied as above, shall be uniformly covered with hard, clean, dustless pea gravel, all of which will pass through a five-sixteenths ring and be retained on a one-fourth inch ring, to the amount of one cubic yard of grit to seventy square yards of surface. The grit shall be applied immediately after the bituminous material is applied, and the same shall be rolled immediately thereafter with a road roller, as above specified, until there results a firm and smooth surface satisfactory to the engineer and inspector.

Franklin County has also adopted well-prepared specifications for bituminous materials, these being, in substance, the same as are in use by the leading State highway departments and large cities which are recognized as doing the best possible work in the construction of modern bituminous macadam suburban pavements.

In the construction of new macadam pavements, either of the water-bound or the bituminous type, the County Commissioners and the county surveyor lay particular stress upon one thing that is only too often neglected in the construction of pavements of these types, and which is, therefore, worthy of particular mention. This is in the grading and preparation of the subgrade. Particular attention is paid to the width and the bases of all cuts, and to the tops of fills, all of which must in every case conform to the cross-section and plans as prepared by the county surveyor. The side slopes on fills and in the cuts are generally one and one-half to one, excepting in unusual cases, thereby, in the generally level country which comprises the county, eliminates slides and tends to keep the ditches open and in good condition.

Another concrete example of the case that is used in grading is that the county surveyor requires that after the grade has been completed, and before any foundation material is placed on the subgrade, a road grader shall be run over the subgrade until the surface is uniformly crowned. Then the subgrade shall be thoroughly rolled with a self-propelled road roller weighing not less than ten tons, and that after this rolling has been completed, any low places that have developed must be cut out and rerolled until they are even and flush with the contour of the surface. Rolling is also prohibited when the subgrade is too wet.

Another excellent provision that is made is that after the subgrade has once been prepared and accepted by the engineer in charge, as well as at all times during the construction of the base course of macadam, the subgrade must be dry and free from all ruts and dust, and that it must be kept thoroughly rolled, drained, and maintained in the same good condition that it was at the time it was accepted by the engineer. This invariably proves an incentive for the contractor to have his material for the base course on hand so that the material for this course can be placed as soon as the subgrade is accepted.

Franklin County also provides that private driveways entering property from the roadway shall be well constructed. These private driveways must be twelve feet in width, uniformly crowned and sloped in accordance with the prepared plans and specifications, and constructed to the satisfaction of the engineer in charge of the work.

In paying for grading, Franklin County authorizes compensation only at the contractor's bid price per square yard, which includes excavation of all classes. It is also required that all fills shall be made from excavated material. Included in grading under the Franklin County specifications are excavation and waste excavation and embankment and borrowed embankment. The bids for grading are required in all cases to include the dirt berm or shoulder which is to be constructed in each side of the macadam roadway.

*Preparing the Subgrade.*—The contractor will be paid per lineal foot for preparing the subgrade, including the earth berms, between the stations as indicated on the profiles of the road. The preparing of the subgrade over the remainder of the road is included in the price of grading.

The preparing of the subgrade between certain stations indicated on the profile shall be done by the use of road graders, scarifiers, or by spiking with a road roller. The road shall then be uniformly graded, as indicated by the engineer's stakes, and crowned as shown on the plans and cross-section (unless otherwise directed by the engineer) to the satisfaction of the engineer. Any places not properly crowned or graded, or not wide enough, shall be prepared by adding or removing the necessary material. The subgrade, when completed, shall have a smooth and uniform surface, and shall conform to the grade indicated by the engineer's stakes. The subgrade shall be thoroughly rolled with a self-propelled road roller weighing not less than ten tons, and, as in the case of grading, this rolling will not be permitted when the subgrade is too wet. Regarding any low and irregular places which may develop during this final rolling, the same provisions apply as will be found in another part of this article under the grading details.

*Dress Grading.*—Berms, slopes, and ditches shall be dress graded, and all such dress grading shall be done by means of a pick, shovel, and mattock.

It is required that all slopes be regular and smooth throughout, and that part of the road between the edges of the macadam (or other metal) and the shoulders, or inside lines of the ditch, shall be true to the grade as shown on the plans and cross-sections, and said shoulders, or inside line of the ditch, shall be in a true line longitudinally, parallel with the macadam and thoroughly rolled. The engineer sets stakes in the ditch, to line and grade, for the dress grading, and before the final acceptance, the road must have a neat and finished appearance, and conform to the profile, plans, and cross-sections throughout. Payment for this dress grading is paid for per lineal foot measured on the center line of the road.

### LIGNIN LIQUOR BOUND MACADAM

*Condition of the Macadam Surface.*—Where a lignin liquor surface treatment is to be applied, it is required that the surface of the macadam shall be in first-class condition, free from holes, ruts, tracks, etc., and have a uniform and even appearance, and all voids shall be thoroughly filled with a grout composed of limestone screenings and water, after which the application of the lignin liquor shall commence.

*Method of Applying Lignin Liquor.*—The lignin liquor shall be mixed with water in such proportions as shall be ordered by the engineer in charge. The water that is to be mixed with the lignin liquor shall be placed in the sprinkling wagon first, after which the lignin liquor shall be added.

The sprinkling with the mixture of lignin liquor and water shall continue until the road has received a treatment for its full width, of one-quarter gallon of the lignin (not the mixture) to the square yard. After the roadway has set, but not entirely dried out, the balance of one-quarter of a gallon of lignin liquor to the square yard shall be applied to seventy-five per cent. of the width of the roadway, using a mixture of one part lignin or two parts of water.

The lignin liquor shall be applied to the roadway by means of an approved sprinkler which can be regulated so that a uniform distribution is obtained, and so that not over one-half of the amount of binder required shall be spread to the square yard on each trip of the sprinkler. The sprinkler shall be equipped with the necessary brooms, so arranged as to sweep forward any axcess material that does not immediately penetrate into the surface.

The application of this mixture of lignin liquor and water shall be made only as fast as the macadam will absorb it, and not so fast that it will run off on the sides or saturate the subgrade. The contractor will not be permitted to make the application of lignin liquor to the roadway during freezing weather.

The price bid per square yard shall include the cost of furnishing, hauling, applying, and all necessary appliances and expenses incidental thereto.

### MAINTENANCE IN FRANKLIN COUNTY

Ohio is generally far behind other States in proper and systematic maintenance of the large mileage of well-constructed highways that she is building. This applies alike to the work being done, and which has been done in the past four or five years. The writer is compelled to say with regret that, excepting in a very few counties, as well as on the main market and

inter-county roads, the two latter constituting the State highway system, the general practice seems to be to construct an excellent highway, and then to pay no further attention to it until it has broken through, or it has started to ravel badly. There is very little systematic maintenance, which alone will save any type of road ever constructed, in the State. And maintenance is actually more important than is construction, as the benefits of good construction, good engineering, and good materials are entirely lost if there is no maintenance.

But it is here again that Franklin County comes to the fore and stands out prominently. Her commissioners, her county surveyor, and the deputy county surveyor are all firm believers in giving a road, once it is improved, the proper care and maintenance. They also believe in repair work when it is first needed, and this work is all done by the county forces.

The road authorities of Franklin County are firm believers in the patrol system of maintenance, and expressed themselves on this point in no uncertain terms to the writer; and the roads that they have to show bear ample evidence of its value. But they are handicapped; for, with the funds available, they are unable to install a complete patrol system, such as is used in Massachusetts, New York, Pennsylvania, Connecticut, Maryland, and other States, and by many counties in all parts of the country. But they have done the best they could under the circumstances; they have installed, and are operating most successfully, a modified form of the patrol system. They saw, not only in their own county but in other counties which they have visited, the results of the lack of this system. Let us see what they saw, and how it worked. It was, and is generally, something like this: an investment of a million dollars of the taxpayers' money—in some counties considerably more; numerous roads are improved annually, but these roads are expected to remain in good condition without any further care or expense; but, even in the case of brick roads, they start, after a year, or two years, or three years, to need repairs; the commissioners have then called in a contractor to repair large patches of the roads, or the farmers and others will dump broken stone on the broken stone roads, or gravel on the gravel roads; traffic is then expected to smooth out and compact this stone or gravel; but later in the same year, or at the beginning of the next spring, it was found that other, and possibly adjoining sections of the road, were again going to pieces, the operation of the previous year was then repeated, so that there was never a year, or hardly ever a part of any year, that the road did not have its bad sections.

The present road officials of Franklin County could not see the economy of procedure of this kind. They looked at it as the officials of a railroad do, or as the owner of a factory does. The former would not build a railroad and operate the rolling stock on it year after year without maintaining the roadbed and without maintaining and repairing the locomotives and cars. Neither would the owner of a factory build his factory and operate it year after year without going over and maintaining his power plant and the machinery, of whatever type, installed therein. And it would be just as great folly to neglect the railroad or the factory as to build the country highway and then pay no further attention to it until it started to go to pieces. The railroads and factories have all, or nearly all, taken up the great "Safety First" policy, and have found out that it saves them large sums of money annually. This same policy should apply to every road built in the whole country to-day. This means that the rut should be attended to, and the hole should be fixed, and the crack cleaned out and filled, not after a few months, or a year, but the day that it first appears, or the day following.

The modified patrol system that is used in Franklin County is operating very successfully, and would be more successful if it could be materially expanded, or enlarged upon. The county usually, under the present system, has about $60,000 annually for the repair and maintenance of its improved roads; about $10,000 of this is paid out for labor (the patrolmen), and the balance is expended for materials and supplies. There is also available the sum of $60,000 annually, out of the tax levy, for bridge repairs and the construction of small culverts, so that these repairs and improvements do not have to come out of the road repair and maintenance money provided annually.

The men employed under this patrol system are given steady employment, winter and summer, so that they are experienced. It has been proved by experience that good men cannot be secured for this kind of work if they are only given employment eight or nine months of the year and then laid off the balance. These men are divided into maintenance crews of twelve men each. In the winter when the roads are frozen, they work on fences, bridges, etc., so they they are generally kept busy even in the bad weather. There are five of these crews.

Stone for maintenance is distributed along the road in piles, and also at all road intersections. The distributing is done in the fall, starting about the middle of September, so that it is ready for work early in the spring. This also has the added advantage of eliminating unnecessary hauling over the roads in the early spring when they are naturally soft and more readily injured than at any other time. This material is a special repair mixture of, as nearly as possible, the same stone of which the road was originally built. It is graded from screenings to inch and a half stone.

These five maintenance crews start out as soon as the frost is out of the ground to do their first work on the roads. Each crew is fully equipped with road-building and maintenance equipment, as the county owns a large amount of modern equipment. During the maintenance season, extra labor and teams are hired where they are needed. The work is principally on the macadam roads, as the county is so divided that each section is well covered by a completely equipped crew. All of the roads in the locality in which the crew starts to work are covered before the crew moves along to another section. Generally not much work is done on the gravel roads, although when a crew is passing over this type of road from one macadam road to another, or from one maintenance section to another, these roads will be given proper attention and the necessary repairs made. This applies also to the trimming of shoulders and the cleaning out of all side ditches, culverts, and drainage structures, as this work is done on all improved roads by the maintenance crews. The maintenance crews do not touch any of the earth roads, as these are taken care of and dragged by the township trustees, as provided for under the Cass Law. The county is well divided, so that there are no long jumps for these maintenance crews to make when moving from one section to another. All bituminous material is hauled out on the roads to the points where it will be needed, and it is always arranged that it is there some time in advance of the maintenance crews. So well have things been worked out that, excepting in case of a break-down to the machinery, there is never any delay when the maintenance crews are out on their roads.

Franklin County, as has already been stated, owns a large amount of modern road-building and repair and maintenance equipment; and, to its credit, it can be said that all of this equipment is given the care that such equipment should have. A fine shop has been built at the Infirmary, where this equipment is all housed during the winter. This building is a brick structure, 110 feet long by 35 feet wide, with pits constructed in the floor for the examination and repair of the equipment and automobiles. A complete machine shop has been installed, which makes it possible for the county's own forces to make almost any repair that might be necessary. After the working season is ended, all the equipment is brought in to the winter quarters and it is thoroughly overhauled, repaired, and painted, so that when it is sent out in the spring it is all in perfect shape and really looks like new equipment. This work is usually started in December.

A rather good story is told on a well-known Columbus machinery salesman. This story originated through the attention which is given to the county equipment. The salesman, whom we will call Mr. Jones, is a close friend of one of the County Commissioners, whom we will likewise give a name and call Mr. Smith. Jones sells, among other things, road graders and scarifiers. The county has five King graders and scarifiers, manufactured by the J. D. Adams Company. Jones sells a competing machine, and was anxious to supplant the machines of his competitor with machines of his own make. He had been using his friendship with Smith as the entering lever, but Smith told him that their machines were all in good shape and that there was no necessity for purchasing any more,

(*Continued on page* 60.)

# Factors in Construction of Bituminous Pavements

## Paving Plants

By Lester Kirschbraun, Consulting Chemical Engineer, Chicago

ENGINEERING literature of past years has been prolific with discussion of various features in the production of bituminous pavements, with types of pavement, methods of construction, qualities of materials, and other considerations. Little has been said, however, in regard to the factor of plant ejuipment used in the manufacture of bituminous paving compositions, and as to the effect, in a general way, upon paving work, or the efficiency of various types of plants in producing good or poor pavement mixtures. The writer proposes to discuss somewhat the practical effect of this factor of paving plant upon the finished pavement.

### CONDITIONS ENCOUNTERED

During the writer's experience, situations have been frequently encountered in which contracts have been let for paving work under well-drawn specifications calling for good type of construction, good materials, etc., but when actual construction was commenced, there was found a contractor on the job with a poor outfit for turning out a pavement. The problem then presented to the inspecting engineer, when faced with such conditions, is to produce a good pavement under most disadvantageous and most adverse conditions with reference to plant facilities.

The writer is able to trace a number of instances of bad construction to nothing but this particular factor of inadequate and improper plant equipment, resulting in the production of uneven and frequently totally defective mixture. In fact, this condition has appeared so frequently on account of the large increase in the amount of asphalt construction, and the large number of new and inexperienced contractors entering upon this work, that in the latest specifications a description has been included, covering, so far as possible, the essential requirements for plant equipment. This requirement, as included in the writer's specifications, is given as follows:

### MINIMUM PLANT REQUIREMENTS

**The paving plant shall be of an approved type, properly adapted for producing the character of mixture hereinafter described. It shall consist of separate units for melting and preparing asphaltic cement, a dryer for heating mineral aggregate, a screen and storage bin, having at least two compartments whereby the mineral aggregate may be separated by means of a six- or eight-inch screen into two sizes, that passing through the screen being collected in one compartment, while the rejection is collected in another compartment. Plant shall further be equipped with the necessary devices for weighing separately the fine and coarse aggregate from each compartment of the storage bin. An asphalt cement bucket shall be provided with scales attached in order that the amount of asphaltic cement which is put into the mixture may be properly gauged. The mixing unit shall consist of a twin pug-mill mixer or its equivalent with blades so spaced as to produce a thoroughly homogeneous mixture.**

This description is intended to eliminate certain types of equipment which are favorably regarded by the inexperienced contractor undertaking asphalt construction, with the idea of simple work and large profits. Plants which fail to meet the above description should not be allowed on a paving job, though, of course, much simpler forms of equipment are eminently well adapted to patching and repair work.

It is believed that the formulation and preparation of a good bituminous mixture, capable of withstanding modern conditions of traffic, is a matter of sufficient difficulty and involves a sufficiently high degree of judgment and care, to at least call for the best of facilities in preparing such mixtures; and certainly the inspecting engineer engaged in such work should not be harrassed and handicapped by plant facilities which frequently vitiate and certainly make most burdensome the successful production of a well-planned mixture.

### CHANGED CONDITIONS

In the manufacture of paving plants in years past, it is apparent that the producers of such plants were concerned much more with those mechanical features which tended to greater capacity and ease of mechanical operation, rather than to ease of controlling product. It is only within very recent years that some attention has been paid to this latter factor, and while this tendency is a matter of encouragement to those engaged in controlling paving mixtures, yet it is apparent that there is much room for further improvement in this direction.

Conditions with respect to plant requirements have changed greatly within the last few years. Asphalt paving construction is being called for by cities of much smaller size than heretofore, and a large amount of road work of mechanically mixed type is being laid throughout the country.

As a result of this wider spread use of asphalt surface, the demand for portable plants, either of railway or road type, has greatly increased. The permanent plant which was maintained in the larger cities could be set up with facilities for handling materials which are not generally available in connection with the portable plants.

Again, prior to ten years ago, very little asphalt work was laid aside from a sheet asphalt pavement, whereas, in more recent years, types of bituminous pavements have been devoloped of more complexity, containing stone as well as sand aggregate, thereby necessitating improvement in plant facilities over those available before. It is therefore apparent that as the complexity of our mixtures has been increased and the factor of portability has become so important, more is being demanded of the paving plant to make it adaptable to the latest conditions.

### NEED OF GREATER ACCURACY

It is unnecessary to point out the need for accuracy and uniformity in preparing bituminous paving mixtures. This is particularly true in the newer forms of construction which include a wider range of aggregates than heretofore. It is well known that variations in uniformity permissible in a sheet asphalt mixture are frequently disastrous in connection with asphaltic concrete mixtures. These latter mixtures are much more susceptible to variations in content of asphalt cement than are sheet asphalt mixtures, and not only is this true with respect to the mixtures themselves, but conditions of traffic make it necessary to observe finer points in their preparation than has been the case heretofore.

For example, an asphaltic concrete mixer under heavy automobile traffic must be regulated to narrower limits in composition and within different limits, than is the case in a mixture exposed to light traffic of mixed character. These conditions make it more and more necessary to have plant equipment capable of the most accurate work and susceptible of at least as much control as is required for similar manufacture in other branches of chemical technology. These conditions are being met with by the more progressive manufacturers of paving plants.

### LACK OF SKILLED LABOR

Generally speaking, the labor available for the operation of asphalt plants is of very unsatisfactory character, and is not to be entrusted with carrying out any important operation without the closest supervision. This statement does not, of course, apply to the operations of those concerns who continuously carry, and carefully break in, the labor controlling the most important portions of the mixture manufacture.

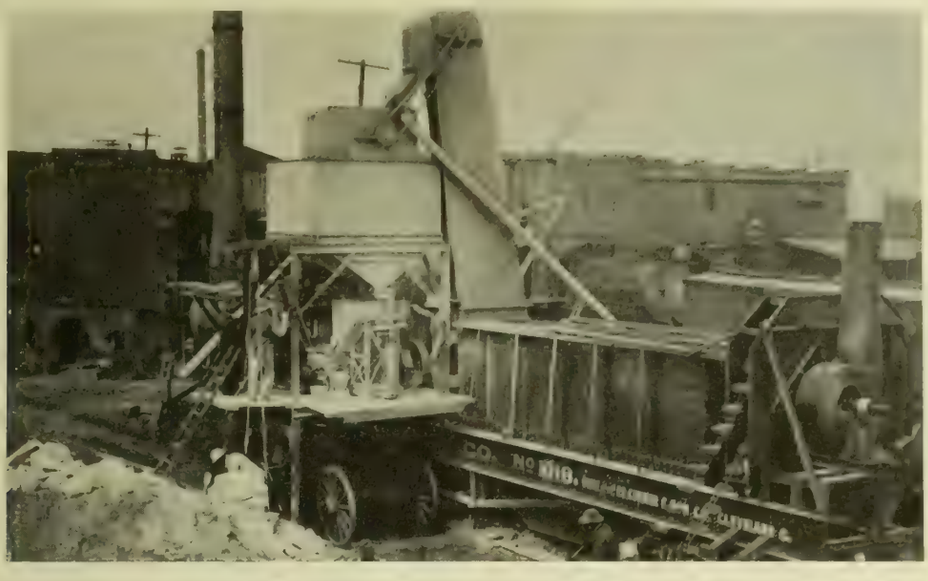
Generally, however, the labor available at the asphalt plant is the kind which is picked up locally, and most frequently such plants come upon the work with scarcely any one but a foreman having any idea as to operation. These conditions make it essential that the important operations in turning out these mixtures be so arranged as to be subject to almost automatic control, so that the labor available need not be depended upon for the success of the work.

*In other words, the paving plant should be made fool-proof or as nearly so as is possible with reference to those features which enter into the control of product.*

The result of crude facilities and poor labor is that, with the best of intentions and frequently with the best of efforts,

inferior results follow, simply because, in the final analysis, the pavement mixture, however well planned or however well set, is dependent for its accurate proportioning upon inaccurate appliances or upon the man at the mixer who frequently holds his job because no one else will stand the dust, dirt, and heat of this portion of the work.

The writer has been frequently amused when visiting paving plants to find, upon asking the plant foreman as to his mix, a ready response in odd and exact figures of different materials used; and then to climb up on the mixer to find the gentleman of color presiding there, overdrawing his A. C. bucket ten or more pounds, the bucket carrying a choice accumulation of dirt,



Cummer One Car Fire Melting Plant owned by the Western Construction Co., Lafayette, Ind.

its tare a matter of ancient history, the amount of filler dependent upon half-filled buckets of variable number and a general promiscuous intermingling and wandering of various grades of aggregate from their respective bins.

The box weights given by the foreman with so much assurance and emphasis on the ground become a matter of chance and purest guess-work at the mixer. Without an inspector almost continuously at the mixer, the well-planned proportions and the careful judgment used in making the mix become a theory, subject to the vagaries of totally unskilled and unreliable laborers.

### THE REQUIREMENTS

The important operations of a paving plant from the point of view of the chemical engineer, may be briefly noted as follows:

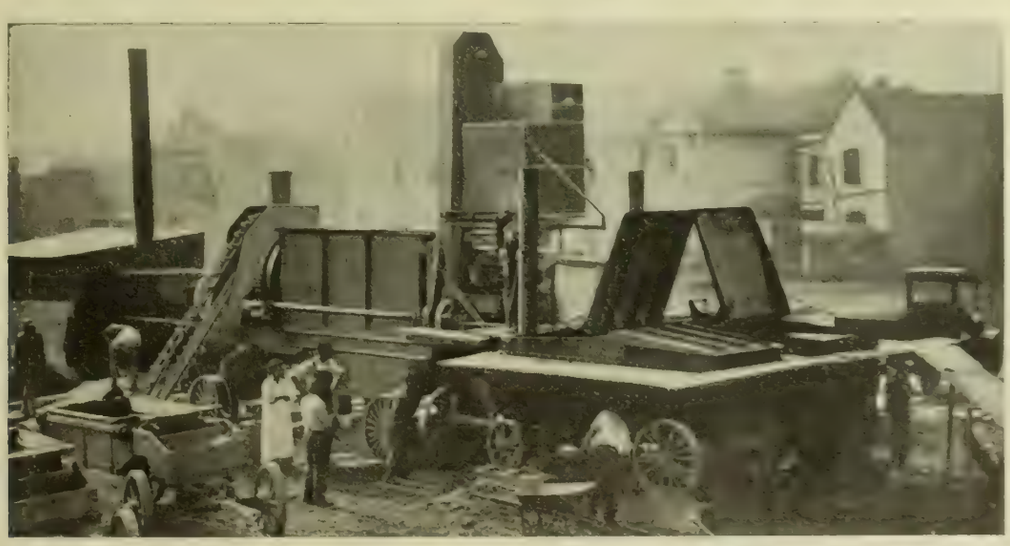
1. Melting of refined asphalt and fluxing to produce asphaltic cement.
2. The proportioning and feed of cold aggregate into the dryers.
3. Control of temperature of aggregate and of asphalt cement.
4. The separation of complex aggregates and distribution into various bins.
5. The weighing out and combination at the mixer of the components of the paving composition.

The ideal paving plant will approach the maximum of efficiency in proportion to the extent that these operations may be controlled automatically or with the least possible dependence upon the labor employed.

If the attention of the manufacturer of paving plants be directed to these features rather than to further improvement in capacity, a great deal will have been accomplished for the benefit of the paving industry. As a matter of fact, the later types of standard plants on the market have generally little to be desired as to mechanical reliability or capacity of output. There is even a tendency for some of these plants to turn out more material than can be given proper attention in laying, so that the time is ripe for more important development in the way of control of product.

### HOW TO MEET THE REQUIREMENTS

The writer desires to point out somewhat generally the character of mechanical devices which he has in mind with reference to accomplishing the above-mentioned important operations. In doing so, however, he desires to disclaim any mechanical ability or knowledge of details by which these rough ideas might be carried out.



A Large Road Plant—1800-yard Capacity

### ASPHALT CEMENT

With reference to preparation of asphalt cement, there is nothing wanting in the best types of present plants. The re-

fined asphalt is melted by steam or indirect fire, and the fluxing operation is sufficiently well regulated by weighing out the required proportions of materials and agitating them mechanically by air or steam until homogeneous. Generally, there is very little danger of overheating. The temperature of the asphalt cement can be subject to very considerable ranges without injury.

FEEDING AGGREGATES

The proportioning of cold aggregates into the dryers as now carried on, is accomplished generally by bringing up to the cold elevator and piling there the individual elements of the aggregates. From these piles one or more men feed the material into the elevator by means of shovels or hoes, regulating



**Portable Road Plant for County Road Building**

the proportioning by the number of shovelfuls of material from each pile. Sometimes this is also done by bringing up the material in wheelbarrows and piling the different portions in one pile, the proportion being regulated by the number of wheelbarrows operating from the stock piles of individual aggregates.

In either case, the labor employed in accomplishing this result cannot be depended upon to maintain correct proportions with measuring units which are, to say the least, crude. Very frequently the wheelers drop out of line or out of order, leaving the other feeders or wheelers working, regardless, at their respective materials. Sometimes the cold elevator will be carrying one element of the aggregate almost entirely, and again some other element will be carried in prepondering proportion.



**A Hetherington & Berner One-Car Plant designed to turn out 2000 or more square yards per day**

This lack of uniformity produces a constantly varying aggregate, and may produce a constantly varying temperature in the heating drums. It would seem possible that this operation of feeding aggregates could be accomplished by separate conveying devices, bringing each component from its pile at predetermined rates of feed, subject to variation by interchangeable gears, or some other simple speed governing device.

By some such arrangement, the proportions of the aggregates could be regulated accurately and uniformly. Even the filling of hoppers or buckets attached to the conveyors operating from each pile of materials might be simply effected.

TEMPERATURE

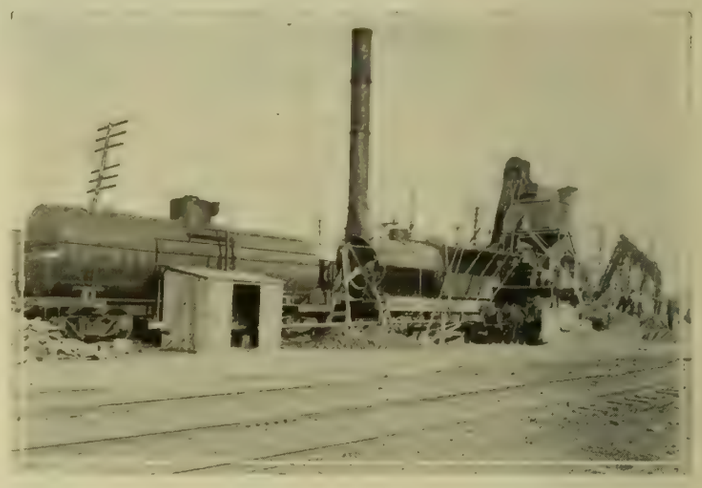
The temperature of mineral aggregate leaving the dryers must be controlled within fairly close limits. If the aggregate is too cold, it will not mix properly, and cannot be handled properly on the street. If too hot, the asphalt cement is injured when tossed about in the mixer in thin films upon the overheated aggregate.

In the present plants, change of temperature will occur most frequently through variations in rate of feed or through delays in turning out the material, which necessitates shutting off the feed and allows the drum to become overheated.

The most common cause of temperature change would be removed by the regular, mechanical feed of aggregates as described above.

In any case, it would be a comparatively simple matter to apply to the control of temperature of the dryers the principle of the electric thermostat which is attached to the draughts of the ordinary house furnace. This thermostat could be so set that when the predetermined upper limits are reached at the boot of the hot elevator, an electric motor would come into operation which would open a trap at the discharge chute from the drum, allowing the mineral aggregate to drop into a screw conveyor, discharging onto the ground.

This conveyor would be interposed between the end of the drum and the hot elevator, so as to remove the overheated



**One-Car Steam Melting Plant owned by Thomas Holahan, Rochester, N. Y Capacity, 2000 yards of 2-inch asphalt per day. Record output, 32,000 yards in 14 days**

material before entering the elevator. Simultaneously, the motor should open the fire doors of the drum, allowing the cold air to enter. When the temperature has dropped sufficiently, and the electric contact is broken, the motor should operate to close the trap, permitting the aggregate again to enter the elevator.

A similar operation could be adjusted for predetermined minimum temperatures.

Present arrangements for control of temperature necessitate taking a sample of aggregate from the boot of the hot elevator and testing it there or at the mixer, and if the temperature is not right, either discharging the aggregate from the top of the hot elevator or from the storage bin. This latter operation is always attended with confusion in shifting teams beneath the mixer or in changing the rate of feed of aggregate. The uniformity of temperature and general satisfactory operation of a plant depend very largely upon continuity, and anything which interferes to shut down or disturb the mixing operation immediately throws the entire work out of gear and leads to other disturbances.

SCREEN AND BINS

Generally, in handling complex mineral aggregates, the proportions are approximately determined at the cold elevator, but in order to avoid segregation in bins or drums, the best

(*Continued on page* 61.)

# A Study of Cushions for Pavements of the Block Type*

Maurice B. Greenough, Instructor in Highway Engineering, Case School of Applied Science, Cleveland, Ohio

THE word *cushion* is defined by Webster as "anything introduced to relieve the shock or jar between parts." Its use in paving practice represents the application of a word which was originally of popular significance only to a highly specialized engineering function. As used in highway practice then, a cushion is that material introduced between the bottom of the wearing surface and the top of the artificial base in pavements whose surface is of a type represented by wood, asphalt, brick, or stone block.

The nature of the filling material between individual blocks has no bearing upon the use of the term, but serves to accentuate some of the properties ascribed to the cushion.

According to the definition and to accepted practice, the primary function of the cushion in pavements of the block type is to relieve the shock of moving loads on the surface of the pavement. Other functions may be attributed to the cushion; to provide a firm and uniform support for individual blocks; to compensate for irregularities in the surface of either the base or the blocks composing the surface, and finally to transmit the effects of surface loads to the artificial base with a uniform distribution of intensity.

A variety of materials has been used for cushions at one time or another, but sand alone or in combination with other materials has enjoyed the widest application for this purpose. Local availability of stone dust or granulated slag has determined their use in a number of instances, but stone dust is similar to sand in its physical characteristics and properties and granulated slag may approach a condition similar to that obtained by the use of cement in the cushion. Bituminous materials have been used to some extent, particularly in wood block construction, but more for the purpose of waterproofing the bottom of the blocks than for providing an elastic cushion.

Wood block pavements have been laid upon a sand cushion for many years, but within the last decade a mixture of sand and cement has superseded plain sand to a large extent. Asphalt blocks have been laid upon a sand-cement cushion through the necessity of providing a firm and uniform support for blocks having so large an exposed area in proportion to the depth.

Up to 1913, sand was almost universally used as the cushion material for both brick and stone block pavements, and it is only since that time that sand-cement mixtures have been employed to any great extent, and in some cases that it has been dispensed with entirely.

During the time that cushions have been in use there have been two important and indicative tendencies developing that are worthy of attention. They are:

1. The increasing emphasis laid upon the necessity of securing a uniformly dense degree of compactness.
2. The gradual reduction of cushion thickness.

The origin of both these tendencies lies in a desire to obtain greater intimacy between individual grains in the cushion and between the surface and base of the pavement as a whole.

An unconfined mass of sand cannot be said to possess elasticity, the property which must be developed to make a satisfactory cushion. The minimum elasticity of sand exists when a multitude of particles are in the free state, and the maximum obtains when those particles are bonded in the form of sandstone or even pure quartz. Therefore, we may say that the degree of elasticity that can be developed by sand is directly proportional to the intimacy of contact between individual grains or to the extent of its confinement. It is true that each grain may possess elasticity, but it may be overshadowed and rendered unavailable by the lack of intimate contact.

We may say then, that a *sand to be suitable for use in pavement cushions should have a uniform grading of particles from the finest to the coarsest,* providing the finest sizes are not composed of materials whose nature or composition may be altered by contact with moisture.

Most specifications for sand cushions seek to secure maximum density by laying stress upon spreading and rolling irrespective of any consideration as to the possibility of ever producing a dense cushion with any amount of rolling in view of the granulometric composition of the sand. The following quotation illustrates the point:

"Upon the foundation as specified, will be laid a bed of clean, dry sand, to bring the surface of the pavement when thoroughly rammed and rolled, to the proper grade. The sand cushion shall be brought to the exact form and crown by means of a template resting on the curbs or on scantling embedded in the sand. The template shall be drawn forward and backward immediately in front of the brick laying, so that the sand cushion shall be maintained constantly at the proper crown. If there still remains any unevenness in the cushion the same shall be brought to a smooth surface by the aid of a lute. Cushion to be rolled with a hand roller weighing not less than ten pounds per inch in width. The depth of the sand shall not be less than one and one-half inches nor more than two inches."

Sand has enjoyed its wide use as a cushion material because of its universal availability and consequent low cost, and because under ideal conditions it may satisfy all the functions of a cushion. A study of sand cushion specifications will show, however, that there has been little or no attention paid to the details which might produce ideal conditions in every case, and that the bulk of attention has been devoted to those properties that are common to sand in the generic sense. At no time have specifications been drawn with the care and accuracy that this feature of pavement construction warrants. In some cases, fine material other than that which would alter its composition in the presence of moisture, has been admitted in a conscious effort to increase the probable density of the cushion.

In early practice, cushions for both brick and stone block pavements were as deep as three inches. There has been a gradual reduction in depth until now we find most brick pavements laid upon cushions from one to one and one-half inches deep, and cushions for stone block pavements are usually limited to a maximum of two inches. Where sand is still used as the cushion material for wood block pavements, one inch is the common depth. One-half an inch is the customary depth for the mortar cushion of wood and asphalt block pavements. Doubtless the reduction in thickness of pavement cushions has been brought about, in part, by smoother surfaced concrete bases.

The intricateness of the cushion problem depends upon the nature of the joint filler in the pavement surface. If the individual blocks composing the surface are free to move without affecting their neighbors, the effect of surface loading is localized to that portion of the cushion underlying each block.

*It is only when the blocks in the surface are bonded to form a monolithic slab that the elastic function of the cushion reaches its maximum importance,* and it is in this connection that so much discussion has recently arisen.

The time has come when we should look upon a pavement as an engineering structure and approach its problems from the same angle that we approach other engineering problems, namely, by methods of exact analysis, based upon the fundamental laws of mechanics. That the problems of pavements are more complex than those of other engineering structures does not prevent the possibilities of an ultimate solution. This complexity of elements has simply inhibited the development of an exact analysis, not prevented it.

The stresses to which pavements are subjected arise from two sources, the loads of traffic and thermal changes. Under the latter may be grouped all the stresses which are due to thermal conditions accentuated by the presence of moisture. Stresses may be set up at any time which arise from a single source or they may be created by combined traffic and thermal forces. An analysis of pavement stresses predicates the fact that a structure is inherently weak whose component parts are not so arranged as to meet stresses from both sources in the most advantageous manner.

For the purposes of analogy a pavement subjected to traffic load may be compared to a loaded arch composed of indi-

*Presented before Section D of the American Association for the Advancement of Science at the Columbus Meeting, December 29, 1915.

vidual blocks united to act in harmony. In the case of the latter, each unit may be subjected to direct compression or shear, while the arch as a whole may be undergoing bending. So it is with a pavement; we may expect forces of direct compression and shear in the individual blocks as the result of flexure in the surface of the pavement as a whole. If we consider thermal stresses, direct tension may be added to those mentioned.

The illustration may be carried still further by comparing a pavement to an arch composed of metal plates connected by rivets. In this case, the plates are subjected to direct tension, compression, or shear; the rivets are subjected to bending and shear. In this analogy, the grout between individual blocks may be compared to the rivets, whose function it is to transmit the stress from one unit to another. While the rivets may be subjected to a true bending stress in the transmission of stress between plates, the grout between blocks in a pavement does not carry direct bending, since the flexure of a pavement surface produces compression in the joints above the neutral axis and tension below. It is further called upon to resist the impact of moving loads upon each block which introduces the element of shear.

The writer would not have these illustrations construed as a belief that a pavement should be constructed as an arch, he wishes rather, to bring out the similarity of conditions surrounding the individual units of both structures.

An incident came to the attention of the writer recently in which the rear wheels of a loaded truck, weighing about twelve tons, proceeding at a rate of about eight miles an hour broke through the surface of a four-inch cement grouted brick pavement laid upon a natural earth foundation, brought about probably by lack of foundation support. The accident served to confirm an opinion that the writer has held for some time that we are working with a very narrow margin of safety in our grouted block pavements as far as shearing resistance is concerned, in view of the fact that we cannot always be sure of adequate support for pavement surfaces.

A series of experiments conducted at Case School of Applied Science by Mr. H. D. Churchill as a thesis in 1915, showed that the ultimate shearing resistance of a four-inch brick perfectly grouted with a 1:1 mixture of sand and cement is approximately 17,800 pounds, an average value of sixteen tests. The tests were conducted by grouting the blocks in strips of three, supporting them on the outside blocks, and applying a load at the center of the middle block. An adjustable strap was placed around the three blocks at the lower edge to prevent bending, so that the action on the grouted joints of the middle block was as nearly pure shear as possible. The load was gradually applied. The figure given as the vertical shearing resistance of the joints represents an adjusted value to include the additional resistance that might be expected had the block subjected to loading been grouted on the ends as well as on the sides.

In the case of the truck which I mentioned, we may assume that the load was distributed in the proportion of one-third to the forward axle and two-thirds to the rear axles, making the load upon one rear wheel about 8,000 pounds. The tires on the rear wheels of the truck were of the caterpillar type, so that it is reasonable to assume that the load would have been transmitted to individual blocks with impact. The pavement was quite smooth on the surface so that on the principle of mechanics that a suddenly applied load produces double the equivalent of a gradually applied load both in the load itself and in the intensity of the stress developed, the probable load exerted upon the blocks in this pavement was 16,000 pounds, as a minimum estimate. The ultimate load of 17,800 pounds was obtained with a perfectly grouted joint, that may or may not have existed in the case under discussion.

The logical conclusion to be drawn from this illustration is that unless the blocks in the surface of a grouted pavement are not adequately supported, shearing stresses alone may be set up in the joints far in excess of the safe limit. If the pavement is constructed with a cushion on an artificial base, it is the function of the cushion to provide such a support and to contribute its elastic resistance, both of which prevent an undue stressing of the joint filler. There is a limit to the elastic deformation that a pavement may undergo and retain its integrity.

The question naturally arises then, "what is the allowable deflection that a pavement surface constructed of the various kinds of blocks may be subjected to, and which may not be exceeded without destroying the property of elastic recovery?"

Unfortunately the answer to this question hinges upon a knowledge of the properties of the several materials, both in themselves and when combined to form a pavement surface, that is at present unavailable. This lack of information, while it may prohibit a quantitative analysis, does not prevent us from making a qualitative analysis, based upon experience with other engineering structures which embody more or less the same elements.

The passage of a vehicle over a pavement produces a deflection in the surface which is distributed over a wide area. In the case of a slab, rectangular in shape, supported and firmly clamped on the four edges, it has been shown that a static load produces deflection over an area two and one-half times as long as it is wide, and it is probable that the affected area of a pavement at any given instant has similar proportions. If, with the slab, the edges had not been clamped, the negative bending moment would have caused them to rise over the supports. The continuity of material in the case of the pavement, serves to effect a condition similar to that of clamping the edges of the slab, so that we may expect, when a deflection is produced by a passing load, that there will be, at the limits of the affected area, a tendency for the surface to rise, caused by the negative bending moment introduced. This, of course, represents the simplest case, when only one vehicle is producing deflection at a time; but the effects produced by more than one vehicle perhaps moving in the opposite direction, would be combinations of the effect of one vehicle. For the purpose of our discussion it is sufficient to point out that the elastic properties of the materials involved are being constantly brought into play in a more or less complex manner.

When the surface of a pavement is depressed by loads the work performed in any given instance is the measure of the resiliency. When the internal stresses created are within the elastic limit of the structure, or within the range through which the deformation has a constant relation to the stress, the amount of the elastic energy stored and recoverable is equal to the resiliency. If, however, the elastic limit of the structure is exceeded, some of the applied energy is dissipated in the form of heat. In the former case, the structure will resume its normal position upon removal of the load, but in the latter there can be no recovery and there exists a permanent deformation.

It must be remembered that in pavements of the block type, with the exception of wood and perhaps asphalt, the materials involved are only slightly elastic, and when combined in the form of a pavement, the elasticity of the structure as a whole depends upon the integrity of bond between the various elements. It is essential that there should be a slight relief for applied loads, in order that the stresses created may build up slowly, otherwise the pavement may be subjected to stresses that are of double intensity due to impact alone, which may be augmented by further impact stresses caused by irregularities in the surface.

We may say then, that to successfully withstand heavy loads, the elastic properties of all the elements of the pavement should be brought into play, and to produce this condition the elements should act in harmony.

In the case of a pavement having a sand cushion, it should be so graded in size of grains, and so densely compacted that none of the energy transmitted to it from the surface shall be spent in causing a re-arrangement of the grains. Such energy is lost as far as assisting the surface in its elastic recovery is concerned, and the surface material is overburdened in proportion to its capacity.

If we assume that a sand cushion fulfills all its functions ideally, not only will it contribute its share of recoverable elastic energy, but it will transmit some of it to the base and it will be brought into play.

Thus we find the introduction of the sand cement-cushion for block pavements to have been caused by a desire to make the cushion such an integral part of the pavement that there should be no chance of losing energy needed to successfully bear heavy moving loads. The presence of the cement assures a cushion of uniform density, and one that can perform all the functions ascribed to cushions in general, leaving nothing to chance.

Not only is the cushion inherently stronger, but it stiffens the whole structure by its complete bond to the surface and the base. In such a pavement, the natural relief against suddenly applied loads is found in the subgrade itself, and the possibilities that any one element of the structure will be overburdened are lessened.

* * *

## Report of the Special Committee on Materials for Road Construction and on Standards for their Test and Use

*(Continued from April issue)*

THE RATTLER TEST FOR PAVING BRICK.

*Construction of the Rattler.*

General Design.—The machine shall be of good mechanical construction, self-contained, shall conform to the following details of material and dimensions, and shall consist of barrel, frame, and driving mechanisms as herein described.

The Barrel—The barrel and the machine shall be made up of the heads, head-liners, staves, and stave-liners.

The Frame and Driving Mechanism—The barrel shall be mounted on a cast-iron frame of sufficient strength and rigidity to support it without undue vibration. It shall rest on a rigid foundation with or without the interposition of wooden plates, and shall be fastened thereto by bolts at not less than four points. It shall be driven by gearing, having a ratio to driven of not less than one to four.

The Abrasive Charge—The abrasive charge shall consist of cast-iron spheres of two sizes. When new, the larger sphere shall be 9.52 centimeters (3.75 inches) in diameter and shall weigh approximately 3.40 kilograms (7.5 pounds) each. Ten spheres of this size shall be used. These shall be weighed separately after each ten tests, and if the weight of any large sphere falls to 3.175 kilograms (7 pounds), it shall be discarded and a new one substituted; provided, however, that all of the large spheres shall not be discarded and substituted by new ones at any single time, and that so far as possible the large spheres shall compose a graduated series in various stages of wear. When new, the smaller spheres shall be 4.762 centimeters (1.875 inches) in diameter, and shall weigh approximately 0.43 kilograms (0.95 pounds) each. In general, the number of small spheres in a charge shall not fall below 245 nor exceed 260. The collective weight of the large and the small spheres shall be as nearly 136 kilograms (300 pounds) as possible. No small sphere shall be retained in use after it has been worn down so that it will pass a circular hole 4.45 centimeters (1.75 inches) in diameter, drilled in an iron plate 0.64 centimeters (¼ inch) in thickness, or weigh less than 0.34 kilograms (0.75 pounds). Further, the small spheres shall be tested, by passing them over the above plate or by weighing them, after ten tests, and any which pass through or fall below the specified weight, shall be replaced by new spheres, provided, further, that all the small spheres shall not be rejected and replaced by new ones at any one time, and that, so far as possible, the small spheres shall compose a graduated series in various stages of wear. At any time that any sphere is found to be broken or defective, it shall at once be released.

The iron composing these spheres shall have a chemical composition within the following limits:

| | |
|---|---|
| Combined carbon | Not less than 2.50 per cent. |
| Graphitic carbon | Not more than 0.25 per cent. |
| Silicon | Not more than 1.00 per cent. |
| Manganese | Not more than 0.50 per cent. |
| Phosphorus | Not more than 0.25 per cent. |
| Sulphur | Not more than 0.08 per cent. |

OPERATION OF THE TEST.

The Brick Charge.—The number of bricks per test shall be ten for all bricks of the so-called "block-size," having dimensions which fall between 20.32 centimeters and 22.86 centimeters (8 and 9 inches) in length, 7.62 and 9.52 centimeters (3.00 and 3.75 inches) in breadth, and 9.52 and 10.8 centimeters (3.75 and 4.25 inches) in thickness. No brick should be selected as part of a regular test that would be rejected by any other requirements of the specifications under which the purchase is made.

(Note by the Committee.—Each brick should be marked by small holes drilled in one of the faces of the brick, and the initial weight of each brick composing the charge should be determined.)

Speed and Duration of Revolution.—The rattler shall be rotated at a uniform speed of not less than 29.5 nor more than 30.5 revolutions per minute, and 1,800 revolutions shall constitute the test. A counting machine shall be attached to the rattler for recording the revolutions. A margin of not more than ten revolutions will be allowed for stopping. Only one start and stop per test is generally acceptable. If, from accidental causes, the rattler is stopped and started more than once during a test, and the loss exceeds the maximum permissible under the specifications, the test shall be discarded and another made.

The Scales.—The scales must have a capacity of not less than 136 kilograms (300 pounds), and must be sensitive to 14.17 grammes (0.5 ounces), and must be tested by a standard test weight at intervals of not less than every ten tests.

The Results.—The loss shall be calculated in percentage of the initial weight of the brick composing the charge. In weighing the rattled brick, any piece weighing less than 0.45 kilograms (1 pound) shall be rejected.

(Note by the Committee. The loss for each brick should also be calculated in percentage of the initial weight of each brick composing the charge.)

ABSORPTION OF WATER BY WOOD BLOCKS AFTER TREATMENT.

Five blocks of average character shall be heated in an oven to a temperature of 110 degrees, Centigrade (230 degrees, Fahrenheit) for three hours, then weighed, and immersed in water for the same length of time. At the end of this time, they shall be taken out, wiped dry, and weighed, the difference in weight before and after immersion, calculated on the weight after heating, being the percentage of absorption.

SPECIFIC GRAVITY AT 38 DEGREES CENTIGRADE OF WOOD BLOCK PRESERVATIVE.

Note.—This is a modification of the method proposed in 1915 by Committee D-7 on "Standard Specifications for Timber," of the American Society for Testing Materials.

A standardized hydrometer shall be used. A set of two with ranges 1.00 to 1.08 and 1.07 to 1.15 will suffice. Before taking the specific gravity, the oil in the cylinder should be stirred thoroughly with a glass rod, and this rod when withdrawn from the liquid should show no solid particles at the instant of withdrawal. Care should be taken that the hydrometer does not touch the sides or bottom of the cylinder when the reading is taken, and that the oil surface is free from froth and bubbles. If the specific gravity is determined at a higher temperature than desired, correction should be made by adding 0.0008 to the reading for each degree Centigrade excess of temperature.

SOLUBILITY IN BENZOL OR CHLOROFORM OF WOOD BLOCK PRESERVATIVE.

From five to ten grammes of the water-free oil is weighed out into a weighed 100 cubic centimeter (3.38 ounces) beaker. Fifty cubic centimeters of the solvent is added, and the solution is passed through a weighted 9-centimeter C. S. & S. No. 575 filter paper in a short-stemmed funnel, the filtrate being passed into the flask to be subsequently used for the hot extraction. The beaker is washed clean from all soluble matter, dried, and weighed. The funnel, with filter paper and contents, is then placed in a New York Testing Laboratory or an Underwriter's form of glass extraction apparatus, and heat is applied from a water-bath or hot plate until the extraction is complete and the filtrate runs through colorless. The filter and contents are then dried and weighed. The increase in weight is added to the increase in weight of the beaker, if any, the result being the weight of the insoluble matter. The weight of the insoluble matter thus found is subtracted from the weight of the material taken for analysis. The difference in weight is the weight of the soluble matter, from which the percentage is calculated.

WATER CONTENT OF WOOD BLOCK PRESERVATIVE.

From 250 to 300 cubic centimeters (8.45 to 10.14 ounces) of the oil is weighed out into a 500 cubic centimeter glass retort, or into a small copper still, provided with a distilling head. Heat is applied with a ring burner, starting with a small flame at the top of the still, and gradually lowering it until all

the water has been driven off. The distillate of oil and water is collected in a graduated separatory funnel, the volume of water in cubic centimeters is read, and its percentage fixed by volume. The water is then drawn off and the oils are returned to the residue in the still. The contents of the still shall have cooled to below 100 degrees Centigrade (212 degrees Fahrenheit) before the oils are returned, and they shall be well stirred and mixed with the residue.

DISTILLATION TEST FOR WOOD BLOCK PRESERVATIVE.

*Apparatus for the Distillation Test.*

Retort.—This shall be a tabulated Jena glass retort of the usual form, with a capacity of 250 to 290 cubic centimeters (8.45 to 9.8 ounces). The capacity shall be measured by placing the retort with the bottom of the bulb and the end of the offtake in the same horizontal plane, and pouring water into the bulb through the tabulature until it overflows the offtake. The quantity remaining in the bulb shall be considered its capacity.

Shield.—An asbestos shield shall be used to protect the retort from air currents and to prevent radiation. This may be covered with galvanized iron, as such an arrangement is more convenient and more permanent.

Receivers.—Erlenmeyer flasks of from 50 to 100 cubic centimeters capacity are of the most convenient form.

Thermometer.—The thermometer shall be of glass, well annealed, and shall undergo no serious change at the zero point when heated up to 400 degrees Centigrade. The space above the mercury column shall be filled with gas, either carbon dioxide or nitrogen, and the thermometer shall have an expansion chamber at the top. The scale shall read from 0 to 400 degrees Centigrade, in graduations of one degree Centigrade, which shall be etched on the stem. The tip of the thermometer shall carry a ring for the purpose of attaching tags. The thermometer shall have the following dimensions:

Total length, 375 millimeters; tolerance, 10 millimeters.

Bulb length, 14 millimeters; tolerance, 1 millimeter.

Distance from zero mark to bottom of bulb, 30 millimeters; tolerance, 4 millimeters.

Scale length from zero mark to 400 degrees Centigrade, 295 millimeters; tolerance, 5 millimeters.

Diameter of stem, 7 millimeters; tolerance, 1 millimeter.

Diameter of bulb, 6 millimeters; tolerance, 1 millimeter.

When standardized, the accuracy of such standardization should be as follows:

Up to 200 degrees Centigrade...to the nearest 0.5° Cent.
200 to 300 degrees Centigrade...to the nearest 1.0° Cent.
300 to 360 degrees Centigrade...to the nearest 1.5° Cent.

ASSEMBLING FOR DISTILLATION TEST.

The retort shall be supported on a tripod or rings over two sheets of 20-mesh gauge, 15.24 centimeters (6 inches) square. It shall be connected to the condenser tube by a tight cork joint. The thermometer shall be inserted through a cork in the tabulature, with the bottom of the bulb 1.27 centimeters (½ inch) from the surface of the oil in the retort. The exact location of the thermometer bulb shall be determined by placing a vertical rule graduated in divisions not exceeding 0.16 centimeters (1-16 inch) back of the retort when the latter is in position for the test, and sighting the level of the liquid and the point for the bottom of the thermometer bulb. The distance from the bulb of the thermometer to the outlet end of the condenser tube shall be not more than 60.96 centimeters (24 inches) nor less than 50.8 centimeters (20 inches). The burner should be protected from drafts by a suitable shield or chimney.

DISTILLATION TEST.

Exactly 100 grammes of oil shall be weighed into the retort, the apparatus shall be assembled and the heat applied. The distillation shall be conducted at the rate of at least one drop, and no more than two drops, per second, and the distillate collected in weighed receivers. The condenser tube shall be warmed whenever necessary to prevent the accumulation of solid distillates. Fractions shall be collected at the following points:

Up to 170 degrees Centigrade (338 degrees Fahrenheit).
170-200 degrees Centigrade (338-392 degrees Fahrenheit).
200-210 degrees Centigrade (392-410 degrees Fahrenheit).
210-235 degrees Centigrade (410-455 degrees Fahrenheit).
235-270 degrees Centigrade (455-518 degrees Fahrenheit).
270-300 degrees Centigrade (518-532 degrees Fahrenheit).
300-315 degrees Centigrade (572-599 degrees Fahrenheit).
315-355 degrees Centigrade (599-671 degrees Fahrenheit).

The receivers shall be changed as the mercury passes the dividing temperature for each fraction. The last receiver shall be removed at 355 degrees Centigrade (671 degrees Fahrenheit), and the drainage from the condenser, etc., shall not be considered as part of the fraction. For weighing the receivers and fractions, a balance accurate to at least 0.05 gramme shall be used. During the progress of the distillation the thermometer shall remain in its original position. No correction shall be made for the emergent stem of the thermometer.

When any measurable quantity of water is present in the distillate, it shall be separated as nearly as possible and reported separately, all results being calculated on a basis of dry oil. When more than two per cent. of water is present, water-free oil shall be obtained by separately distilling a larger quantity, returning any oil carried over with the water, and using dried oil for the final distillation. A copper tar still is a convenient implement for obtaining water-free oil.

FORM OF RECORD FOR DATA CONCERNING THE USE OF NON-BITUMINOUS HIGHWAY MATERIALS

**DATA CONCERNING THE USE OF NON-BITUMINUS HIGHWAY MATERIALS**

**GENERAL INFORMATION**

State..... County.....
Town..... Road Name.....
Limits of Improvement.....
Length of Improvement in Feet.....
Width of Crust or Pavement in Feet (average).....
Area of Crust or Pavement in Square Yards.....
Percentage of Grade (maximum): Length.....feet; .....per cent.
Percentage of Grade (minimum): Length.....feet; .....per cent.
Percentage of Grade (mean): Length.....feet; .....per cent.
Amount of Crown: Maximum..... Minimum.....
Date of Beginning and Completion of Improvement: .....to.....
Hours of Working Day..... Labor Wage per Hour.....
Nature of Subgrade.....
Maximum and Minimum Air Temperature During Year.....

**CLASS OF HIGHWAY OR NATURE OF TRAFFIC**

Amount of Traffic Census for.....hours (average).
Dates of Census: ..... .....

| | Commercial Empty L'd'd | Est. (in lbs.) of Max. Load per in. of Tire | Passenger Vehicles |
|---|---|---|---|
| One horse Vehicles | | | |
| Two- or Three-horse Vehicles | | | |
| Four- or More-horse Vehicles | | | |
| Motor Cycles | | | |
| Motor Runabouts | | | |
| Motor Touring Cars (open or closed) | | | |
| Motor Busses | | | |
| Motor Trucks | | | |

Remarks.—The reporter is requested to note under Remarks (near the end of this form), wherever possible, any special characteristics of the traffic, more particularly a preponderance of any one kind of traffic, speed and wheel diameters, the Committee believing that these factors may affect the actual cost of maintenance.

**FORM OF CONSTRUCTION**

(This is, gravel, broken stone, brick, stone block, wood block, and cement-concrete, and on what type of foundation.)

**CONSTRUCTION AND COST DETAILS**

**A. Foundation.**

1. Material .....
2. Thickness .....
3. Cost per Square Yard .....
4. Estimated Life.....years.

**B. Wearing Course.**

1. Material .....
2. Size of Blocks..... Thickness of Blocks.....
3. Kind of Joints.....
4. Proportions of Aggregate (cement concrete).....
5. Cushion or Bed.....
6. First Cost per Square Yard.....
7. Life .....Years.
8. Average Annual Maintenance Cost per Square Yard During Life of Wearing Course .....

**C. Traffic Data.**

1. Tons per Year.....
2. Average Tons per Yard of Width.....
3. Proportion of Tonnage on Metal Tires.....
4. Proportion of Tonnage on Metal Tires 2 Inches or Less in Width.....

**ITEMS OF COST FOR EACH SQUARE YARD**

| | Foundatior | Wearing Course |
|---|---|---|
| Materials | | |
| Labor | | |
| Superintendence | | |
| Overhead, Including Interest on Plant, Depreciation, Etc | | |

(Not to be filled in by reporter.)

**DATA PER SQUARE YARD**

A-3 First Cost of Foundation.....
A-5 Annual Interest and Sinking Fund for Foundation.....
A-6 Total Annual Cost of Foundation.....
B-8 Annual Maintenance Cost of Wearing Course.....
B-9 Annual Interest and Sinking Fund for Wearing Course.....
B-10 Total Anual Cost of Wearing Course.....

Yearly Cost per 1,000 Tons of Traffic: $\frac{\text{A-6 B-10}}{\text{C-2}}$ 1,000 = .....

NON-BITUMINOUS HIGHWAY MATERIALS
TESTS AND ANALYSES

Broken Stone and Broken Slag

Name and Origin
Specific Gravity
Absorption of Water per Cubic Foot
Abrasion, Percentage of Loss
Toughness
Cementation
Crushing Strength per Square Inch
Mechanical Analysis.....(Use Table at End of Form)
Voids, Percentage of, Loose and Compacted

Gravel

Location
Specific Gravity
Abrasion, Percentage of Loss
Cementation
Mechanical Analysis.....(Use Table at End of Form)
Voids, Percentage of, Loose and Compacted

Sand

Location
Specific Gravity
Mechanical Analysis.....(Use Table at End of Form)
Voids, Percentage of, Loose and Compacted
Tensile Strength in Cement Briquettes, as Compared with Standard Ottawa Sand

Mixtures of Sand or Other Fine Highway Materials, With Broken Stone, Broken Slag, or Gravel

Specific Gravity
Mechanical Analysis.....(Use Table at End of Form)
Voids, Percentage of, Loose and Compacted

Paving Brick

Composition
Name of Manufacturer
Rattler Test, Percentage of Loss

Stone Block

Name and Origin
Specific Gravity
Absorption of Water per Cubic Foot
Abrasion, Percentage of Loss
Toughness
Hardness
Crushing Strength per Square Inch

Wood Block

Character of Wood
Weight of Blocks
Soundness
Rings per Radial Inch
Quantity of Preservative
Absorption of Water after Treatment
Character of Preservative
Specific Gravity at 25 Degrees Centigrade
Specific Gravity at 38 Degrees Centigrade
Solubility in Benzol or Chloroform
Water Content
Distillation
Up to 170 Degrees Centigrade
170 to 200 Degrees Centigrade
200 to 210 Degrees Centigrade
210 to 235 Degrees Centigrade
235 to 270 Degrees Centigrade
270 to 300 Degrees Centigrade
300 to 315 Degrees Centigrade
315 to 355 Degrees Centigrade

MECHANICAL ANALYSIS

Percentages by Weight

| | | | |
|---|---|---|---|
| Passing 200-Mesh Sieve | | | |
| Passing 100-Mesh Sieve and Retained on 200-Mesh Sieve | | | |
| Passing 80-Mesh Sieve and Retained on 100-Mesh Sieve | | | |
| Passing 50-Mesh Sieve and Retained on 80-Mesh Sieve | | | |
| Passing 40-Mesh Sieve and Retained on 50-Mesh Sieve | | | |
| Passing 30-Mesh Sieve and Retained on 40-Mesh Sieve | | | |
| Passing 20-Mesh Sieve and Retained on 30-Mesh Sieve | | | |
| Passing 10-Mesh Sieve and Retained on 20-Mesh Sieve | | | |
| Passing ¼-Inch Screen and Retained on 10-Mesh Sieve | | | |
| Passing ½-Inch Screen and Retained on ¼-Inch Screen | | | |
| Passing ¾-Inch Screen and Retained on ½-Inch Screen | | | |
| Passing 1-Inch Screen and Retained on ¾-Inch Screen | | | |
| Passing 1¼-inch Screen and Retained on 1-Inch Screen | | | |
| Passing 1½-Inch-Screen and Retained on 1¼-Inch Screen | | | |
| Passing 2-Inch Screen and Retained on 1½-Inch Screen | | | |
| Passing 2½-Inch Screen and Retained on 2-Inch Screen | | | |
| Passing 3-Inch Screen and Retained on 2½-Inch Screen | | | |
| Passing 3½-Inch Screen and Retained on 3-Inch Screen | | | |

Remarks

Name
Title
Address

Reporting Officer.

Date.....191.....

* * *

# Oklahoma Department of Highways

## Motor Vehicles and Maintenance of Roads

### Geo. B. Noble, Commissioner

THE Oklahoma legislature of 1915 put into effect the present highway law. Previous to this there had been some semblance of a law of this kind, but it was not popular nor praiseworthy. The present law is not only worthy of favorable comment but is generally popular with all classes except the vicious.

One of the provisions of this law is that tax on all motor vehicles shall be collected by the Department of Highways. The amount of tax of machine owners is based on the horse-power of such machine. The rate is fifty cents per horse-power for the first registration in Oklahoma, and a decrease of ten cents per horse-power for each registration thereafter in Oklahoma, until the rate reaches twenty cents; thereafter it remains at twenty cents during the life of the car.

The taxes thus collected are disposed of as follows: Ten per cent. retained by the State treasurer, the balance going back to the treasury of the counties from which the machines are registered. Cities of the first class or those operating under a charter form of government receive from the county treasury twenty-five per cent. of the taxes collected from machines owned by parties living in such cities, the balance going into a dragging fund or road-maintenance fund of the county. This dragging fund can be used only for maintaining State highways in each county.

This law was in operation for only six months in 1915, having gone into effect July 1. For that season we charged only twenty-five cents per horse-power. To January 1, we had registered over twenty-six thousand machines, the taxes amounting to about $155,000. During the year 1916, we estimate our collections will be not much less than $400,000, and as we consider the maintenance of roads, after they are constructed, of great importance, and inasmuch as this money must be used for this purpose only, we consider this a very wise provision. We estimate there will be about six thousand miles of State roads constructed in Oklahoma in 1916, and with $400,000 at least to be used in dragging these roads, we hope to show the automobile men who have paid their taxes that their money is really doing some service.

The payment of this tax exempts the motor vehicle owners from an *ad valorum* tax by any county or city. The rate is reasonable, and inasmuch as it is used for the good of roads only, the owners of motor vehicles are really pleased to contribute their tax.

Persons who handle motor cars for sale pay an annual tax of $15.00, and this tax is disposed of in the same way as the tax on cars.

After all the completed State roads in a county have been maintained in each year, and there remains in the dragging fund a balance, such balance may be transferred by the county commissioners into a State road construction fund and used for any purpose that such fund may be expended for.

ROAD AND BRIDGE WORK

*Latimer County.*—T. W. McLaughlin, Wilburton, county engineer. Board of County Commissioners have authorized Damon Township to vote $10,000 to build road over Blue Mountain.

*Cotton County.*—Edgar J. Leaverett, Waurika, county engineer. S. W. Childers, Walters, county surveyor. Eighty-two miles of State roads surveyed. Contract let for six steel bridges on State roads. Twenty miles of roads graded by private donation. Considerable local interest in road work.

*Cimarron County.*—F. M. Sandford, Arnett, county engineer. Plans being made for the 200-foot low-water concrete crossing over Beaver River. Construction of State roads in progress. Abundance of road-building material.

*Ellis County.*—F. M. Sandford, Arnett, county engineer. About thirty miles of sand roads formerly impassable temporarily constructed and in good condition by use of hay and straw. Three miles of sand-clay road constructed. Road-building material in abundance.

*Kingfisher County.*—C. R. Steele, Kingfisher, county engineer. Contract let for fourteen bridges. Five are concrete arches, five steel trusses, and four steel I-beams. Work now in progress. Contract price for fourteen bridges, $17,526. Considerable road work in progress.

*Alfalfa County.*—Wm. Haviland, Alva, county engineer. Fifty-six miles of State roads graded and work still in progress. Number of steel bridges being constructed by Kansas City Bridge Company.

*LeFlore County.*—Dan W. Patton, Poteau, county engineer. Work now in progress on three steel bridges and twenty-seven miles of roads. Work covered by bond issue in Wister Township. Surveys being made for thirty miles of road in Summerfield Township. Forty-five thousand dollars in bonds voted in Tuskahoma Township for roads. Surveys in progress. Forty miles to be built. A county bond issue of $500 contemplated to permanently build State road system.

*Atoka County.*—B. C. McClearey, Atoka, county engineer. Survey in progress on Jefferson Highway.

*Haskell County*—Roy Grace, Strigler, county surveyor. Township bond issue contemplated for road and bridge construction.

*Garfield County.*—B. F. Lewis, Enid, county engineer. Over one hundred miles of State roads constructed and in excellent condition.

*Pawnee County.*—Jno. W. Griesel, Pawnee, county surveyor. One mile of State road built under supervision of a representative of the United States Department of Agriculture; earth construction. Twelve miles being graded.

*Pittsburg County.*—T. W. McLaughlin, Sr., county engineer, McAlester. Many miles of State roads completed and in good condition, including the Jefferson Highway, which passes through Pittsburg County.

*Comanche County.*—S. A. Joyner, Lawton, county engineer. Contract let for two concrete bridges and five miles of State road. Bids being asked for construction of additional State roads.

*Coal County.*—E. E. Gravelle, Coalgate, county engineer. Road work progressing, number of convicts being used. The use of convicts found to be profitable.

*Bryan County.*—L. V. Stinson, Durant, county engineer. About forty miles of State roads graded. Several bridges in course of construction and State convicts being used for construction of Jefferson Highways.

*Woodward County.*—J. A. Innis, Woodward, county surveyor. Surveys and road work progressing. Contract awarded to Woodward Concrete and Cement Company at $6,987 for sub-structure up to Spring Line for large reinforced concrete arch bridge, five panels at eighty-four feet each.

*Ottawa County.*—Geo. J. Stein, Miami, county engineer. Road work in progress. Contract let to Missouri Valley Bridge and Iron Company for five steel bridges at $63,436.

GENERAL ROAD WORK

W. P. Danford, acting State engineer for the Department of Highways, has recently made several trips to different portions of the State and reports a progress in road work that is very encouraging. Garfield County probably leads the State in the number of miles of State roads constructed. The present construction is of earth of various types, but there are over a hundred miles of road in Garfield County where it is possible to travel thirty miles per hour with safety when necessary. The culverts and bridges are well constructed and, as a rule, permanent.

In Pittsburg County, the Jefferson Highway appears to be in excellent condition. This road is being built complete through the State, some counties having finished the earth construction and others just starting the surveys. Mr. Danford assisted in starting the survey in Atoka County where there is road-building material in great abundance and an excellent road will be secured by following the abandoned M. K. and T. R. R. bed, which has at least two feet of rock ballast, for about half the distance, or twenty miles.

In Bryan County, thirty State convicts with seven teams are now being used on the Jefferson Highways.

In LeFlore County, they have a machine for the building of roads that has never failed to accomplish results. The machine consists of a people filled with enthusiasm, soil adapted to roads, a gravel pit with an inexhaustible supply of gravel that has wonderful cementing qualities, and some money with which to construct roads. They also have a competent engineer. Mr. Dan Patton is county engineer and mayor of Poteau, the county seat and a live, progressive town of three thousand.

Mr. Patton has some difficulties to overcome in road building. Accompanied by Mr. Danford, he recently made a trip over the Winding Stair Mountains with a view to locating a road. These mountains are all that the name implies and it was determined that the most feasible route would be the old military road, located by an army engineer eighty years ago, from Ft. Smith, Arkansas, to Ft. Towsen, Oklahoma. This piece of road will likely be the most difficult to construct of any in Oklahoma. Mr. Patton will start on the survey at once.

The County Commissioners of Creek County, with their county engineer, M. E. Binckley, are accomplishing great results in building good roads economically under difficulties.

THE ROAD COURSE

Jas. I. Tucker, professor of civil engineering, University of Oklahoma, and consulting engineer, Department of Highways, has prepared for the Extension Division of the university a correspondence Road Course that has been available to the public for the past three months, and the results so far are very encouraging, over thirty students having enrolled, the majority of whom are making good progress.

This course consists of twenty-four lessons, furnished at a very nominal fee, and is based on the experience of road-building experts over the whole country. It is designed to assist, primarily, the county engineers and surveyors, but will also be of great interest and benefit to any other official or person interested in road construction.

Since a part of the duties of the Department of Highways is to educate the public and assist them in a proper compliance with the road law and economical construction of permanent roads, the department gladly seizes this opportunity to recommend the course and help in every way to increase the enrollment.

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## North Carolina Highway Commission

### Its Organization, Growth, Work and Future Plans for Highway Improvement in that State

THE State Highway Department of North Carolina, organized in May, 1915, has, in the short period of time since it was organized, in addition to the many details of its organization, taken up the following work:

The development of a standard of procedure in which it wishes to establish rules for and under which it will render the assistance, as authorized by the law, to the various counties of the State; rules whereby each county will be dealt with on a fair and equitable basis, giving preference to no county or section of the State, no matter what the influence might be that could be brought to bear, and arranging the machinery for this distribution of service in such a way that it might be evident to the inquiring public that such rules as established had been in all cases rigidly adhered to.

It is also the purpose of the commission to arrange, as soon as possible, for the publication of standards for roads, bridges, and culverts, also for the publication, from time to time, of maps showing the road systems of the counties and State. These maps will be in sufficient detail to serve as a guide for travelers in visiting any part of the State or any section of a county.

Since the organization of the department, in May of last year, between forty and forty-five counties of the State have applied to the department for assistance under some form or other, varying from complete supervision of the work in the county or township to simply giving lectures or advice, and this assistance has embraced counties from Cherokee in the southwest to Currituck in the northwest, and from New Hanover in the southeast to Ashe County in the northwest, having given some form of assistance in the counties occupying the four corners of the State.

BRIDGES

We have been endeavoring to place, so far as we have been permitted to do so, the bridge work of the State on a more business-like basis. The usual conditions of the highway bridge work have prevailed here as in many other places where the bridge contractors have supplied counties with plans, as well as prices, with the resulting lack of real competition and poor bridges, waste of money, and dissatisfaction. Where satisfactory prices could not be obtained for work done under plans made by the State commission, the commission have taken over the construction of bridges for the counties, with the result of better bridges and a large saving in money to the counties. We hope to get this part of our work in such shape that contractors for this work will be in position to give the lowest possible prices on plans furnished by the commission, with full assurance that fair and just treatment will be accorded each bidder. This means will result, we hope, in entirely eliminating, on the part of the counties, the "auctioning" of their bridge work, and on the part of the bridge contractors the "pooling" of their bids, as this practice is as reprehensible on the part of one as on the part of the other, and results in poor work always and means frequently a loss to both parties concerned.

MAINTENANCE

We are proposing to pay particular attention, during the year, to maintenance, and have already planned and estab-

lished such projects in several counties. We have in hand the general idea of a system of State maintenance for the roads that would be called State roads, including finally all the inter-county roads, gradually linking up all the county seats into a system connecting with the through roads, all to be maintained under the supervision of the State commission with money derived from some general State fund properly applicable to such purposes; such a system of inter-county roads connecting with such through highways as the National Highway through the western part of the State, the Washington-Atlanta Highway through the eastern part of the State—both roads being through roads north and south—the Central Highway, the Charlotte-Asheville Highway, the Charlotte-Wilmington Highway, running east and west, would soon form, under proper maintenance, not only such a system of continuous good roads for the entire three hundred and sixty five days of the year, as we have been dreaming of, but would give to the counties of the State an object lesson on the value of maintenance that would be invaluable.

The highway commission is soon to have the needed equipment for testing materials most used in the road work of the State, such as soils for surfacing roads, sand for sand-clay roads, clay for the same purpose, and cement and sand for concrete used in roads and bridges.

The immediate work now being carried on under the direct supervision of the commission, and worth mentioning here, is a proposed patrol system for maintaining the Central Highway from Beaufort, North Carolina, on the coast, to the Tennessee line west of Asheville in the mountains—a distance of more than four hundred miles. An itinerary in co-operation with the United States Office of Public Roads and Rural Engineering will be conducted over the route during April, in order to secure the co-operation of the various counties along the route.

There are also three other through road projects being conducted by the State commission. Surveys are now being made on a road to connect Wilmington, North Carolina, with Fayetteville, North Carolina, through the counties of New Hanover, Pender, Sampson, and Cumberland, the road to be known as the Wilmington-Fayetteville Highway, and will connect with the Washington-Atlanta Highway at Fayetteville.

Surveys are also being made on the road known as the Charlotte-Wilmington Highway, a State highway approved by the legislature several years ago.

The third is a highway to be known as the Charlotte-Albemarle-Pinehurst Highway, which will be surveyed soon. This road passes through the counties of Mecklenburg, Cabarrus, Stanley, Montgomery, and Moore, connecting Charlotte directly with Pinehurst, the noted winter resort in the sand-hill region of the State.

The commission has under direct supervision and control the construction of two bridges of reinforced concrete, one of them 370 feet in length in Franklin county, and one 450 feet in length in Edgecombe County, besides a number of smaller steel and concrete bridges.

WORK BY COUNTIES

*Caldwell County.*—Lovelady Township has built three miles of road during March. In Hickory Township they built three miles of road in thirteen work days during March. The right-of-way work was extra heavy, but the grade work was light.

The citizens in the east end of the township have graded about one mile of road, and they have about one mile more to grade to connect with the main highway. They are very enthusiastic, and this is free work, as they feel that there is no use to have a good road and not have any way to get to it.

*Lee County.*—During the past month this county has cleared 6.35 miles of road, and has graded 2.8 miles, with a roadway of 26 feet. They have surfaced eight miles of sand-clay and thirty miles of gravel. One culvert has been put in, which is a ten-foot arch rubble masonry.

*Sampson County.*—The road work is progressing very nicely. Hired labor is being worked in several parts of the county.

*Robeson County.*—The building of the Wilmington-Charlotte Highway is giving the road work of Robeson County new life, and much interest is being shown for better roads.

The Wilmington-Charlotte Highway will pass entirely through the county from east to west, coming from Boardman via Lumberton, Pembroke, Maxton, and Laurinburg, on to Charlotte. Chain Gang No. 1, with forty-two men and eight mules, equipped with wheelers, drag scrapers, pile driver, and other equipment, is now located just east of Lumberton and will build for Robeson County a thirty-foot highway, surfaced with sand-clay, through the entire county. Practically the western end of the route has been completed and about thirteen miles of the eastern end remain yet to be built. The work is being done under the supervision of the State Highway Commission.

Mr. D. H. Winslow, superintendent of construction, of the Office of Public Roads, Washington, D. C., delivered a most interesting lecture on road maintenance before the Chamber of Commerce at Lumberton on March 9.

Under the advice of the State Highway Commission, the commissioners of Robeson County will buy more mules and other equipment to strengthen their road forces.

*Guilford County.*—The county commissioners, at their board meeting, voted unanimously in favor of the construction of a concrete public road from Greensboro to High Point. They agreed that a sum of money not to exceed $125,000 shall be borrowed by Chairman W. C. Boren of the board, and the work shall go forward at an early date. The concrete road to be built will cost between $12,500 and $14,000 a mile. About two miles have already been laid in the direction from High Point. The remaining distance is something more than ten miles, and it is estimated that the total cost of the road will be between $150,000 and $175,000. This road, when completed, will be equal to any speedway in the country.

*Harnett County.*—Stewart's Creek Township voted road bonds some time ago, and began work in February, which consisted of surveying and laying of the new roads. The first one on which they worked was the road from Duke Bridge to Bunn's Level, then from Duke Bridge to Linden.

*Richmond County.*—The road work in this county is progressing very nicely. It is believed that by the middle of the summer Richmond County will have a splendid system of good roads. Under the chain-gang system, the county has two road forces, one known as the upper force, and the other as the lower force, and the work for both forces has been worked out for them for the next several months.

The upper force, that for a year has been above Ellerbe in the Stelle's Township section, is now building a road east of Ellerbe towards Gibson's Mill to intersect the Rockingham-Gibson Mill road. From there they will build one between the mills and Watson's Place, and out by Millstone Branch to the Was Bennett place by McQueen's and to Jones' Ford. When completed, this road will shorten the distance from Rockingham to Jackson Springs by at least five miles and opens the section between Ellerbe and Hoffman that has no good roads.

The lower force has been in Marks Creek Township for the past three months. They will finish this in the near future, when they will take up the work on the Hamlet-Hoffman Road to Hoffman and work out by Naked Creek to meet the upper force.

The Hamlet-Gibson Road in Marks Creek is now in good condition. The force have finished this and let the dragging contract to Bod Scholl, of Ohio.

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## Drainage and the Preparation of Subgrades

By John H. Huber

IN THIS article, it is my intention to review the subject of drainage in a general way, and also to describe in as brief a manner as possible some concrete examples of poor drainage conditions that I have encountered, and how they were successfully taken care of.

Most of the methods hereafter mentioned are used by and the present general practice of the New York State Department of Highways.

While almost every person connected with the construction and maintenance of highways realizes the importance of proper and adequate drainage, I think there are more failures due to the lack of drainage than are due to any other cause. This is due partly to the incorrect methods used, partly to inexperience, and to a large extent it is the fault of the engineer in charge of the work in trying to keep the cost of the construction as low as possible at the expense of proper drainage.

The drainage problems in highway construction begin with the preliminary surveys, the purposes of which are to actually show the conditions as they exist. Information on the location and sizes of all existing drainage structures, such as catch basins, ditch crossings, culverts and bridges, should be given without exception in every case. All information regarding the location and the direction of flow of all water courses should also be given as should complete and detailed notes on all soil conditions in the vicinity.

Recommendations should be made as to the proper sizes of all new drainage structures that may be required, together with a complete layout for the new drainage system. By this I mean that where new culverts are necessary, the best locations for them should be shown, as should also existing culverts that are to be taken up and built to fit the line of the stream, providing for the quick run-off of the water.

The preliminary survey notes should also, in all cases, contain information to assist the designer in laying the new grade line for the improvement as proposed.

I wish to emphasize that the completeness of the preliminary survey is of the utmost importance, especially as it relates to the drainage conditions, and our experience in the New York State Department of Highways has been that, where this survey has been carefully made, and the proper time and study given to the recommendation notes, we have been getting, almost without exception, the very best results.

The subject of drainage is logically divided into two parts, namely, surface drainage and sub-surface drainage, and these will be discussed in that order.

### SURFACE DRAINAGE

The crown of a pavement is almost entirely a matter of surface drainage, and the character of the type of construction used has much to do with the amount of crown that is permissable. In New York State we have adopted a crown of one-half inch per foot for water-bound macadam, three-eighths of an inch per foot for bituminous macadam, and one-quarter inch per foot for brick and concrete pavements. Earth roads should be given a crown of one inch per foot.

The crowns on water-bound and on bituminous macadam highways are usually made by giving the sub-grade the same crown as intended for the finished pavement. On this account, care should exercised to see that this part of the construction is properly done. The inspector should frequently check the grading lines, and when the loose stone is being spread he should always see that the gauge blocks are moved continually with the spreading operation. After the top course is spread and rolled once or twice, any irregularities of the crown should be corrected by taking out or adding stone.

The crowns on block pavements are given by striking off a sand or mortar bed with a template cut to the crown desired. This template rests on side forms, wooden skids, or on the curbing in wide pavement construction, and on the edging for our standard sixteen-foot width pavements.

For widths up to and including twenty-four feet, good results can be obtained with a template reaching clear across the pavement, but for wider pavements, it is recommended to shape the bed in two or more operations, depending upon the width.

For wide pavements, where there are either single or double car tracks running along the center of the pavement, it is our practice to set the tops of all rails at the theoretical elevation figured on the crown slopes from the center of the street to the outside rail. The pavement between the rails is given a slight camber, usually about one-half inch.

For shaping the sand or mortar bed between the outside rail and the curb where a straight line is desired, the center should be raised slightly to avoid a concave surface.

In resurfacing old macadam with the Topeka specification, or with other bituminous surfaces of that type, it is best to shape the crown by using a template. This can be done by spiking down side forms of timber at least six inches wide and of the necessary thickness. Holes should be bored to take an ordinary boat spike fitted with a large washer.

On these side forms a wooden template should be run. This is not for screeding purposes, but merely to aid in spreading and raking the material for depth and crown, which not only insures a better crown for every foot of the highway, but which also eliminates the wavy appearance too often seen in this type of construction.

The crown on concrete pavements of our standard sixteen-foot width is made by screeding the concrete with a strike board. This strike board should be heavy enough to cut the concrete and not ride over it, and about two feet longer than the width of the pavement. This is important if a wavy surface is to be avoided. The screeding operation is accomplished by sliding the strike board back and forth on the top of the side forms at a slight skew to the center line of the roadway.

For this reason, in order to prevent a flattening in the center of the pavement, a parabolic section is used.

In laying the crown in the strike board, the curve should be continued to the very end. This absolutely insures a curved surface in the finished pavement.

The crown in concrete pavements depends to a large extent on the consistency of the concrete; for if the concrete is too wet, there will be a flattening due to its running away from the center. On wide concrete pavements, the concrete is usually gauged with a template cut to the desired crown, and then floated over with a long-handled wooden float.

Machines for screeding and striking crowns in concrete pavements are now coming into use. A machine for this purpose is now being used in the construction of the concrete roads in Wayne County, Michigan, and it is reported as being very successful.

The cross-section of a pavement may be a segment of a circle, a parabola, or two inclined planes. Our practice is to use the inclined planes for all types of pavement excepting the concrete pavement, on which type the parabola is used for the reasons already set forth.

In banking pavements on curves, the super-elevation should be sufficient to allow a camber of at least one inch at the center for appearances, and at the same time to provide good surface drainage.

Nothing looks so unsightly in a pavement as a concave surface, and such surfaces should, without question, be avoided in all cases. Crowns on hard-surfaced pavements with considerable longitudinal grade should always be reduced. Our practice in New York State has been and is to reduce the crown one-half. The opposite, however, is recommended for macadam construction, the object being to discharge the water quicker and to prevent its running along the surface of the pavement. I think it is the best practice, however to keep the crown the same to prevent slipping and skidding.

For shoulder treatment we use a slope of three-fourths of an inch per foot for the first half, increasing to a slope of one foot vertical to four feet horizontal to get the standard depth of ditch. The standard depth of ditches in use on our State highways varies from seventeen inches on a brick pavement to twenty inches on water-bound macadam for a thirty-two foot roadway.

I believe that failure in many cases in many miles of road construction in the past has been due to not having the proper depth of ditch. Most of our engineers have learned this lesson from experience, and now, in many cases of new construction, the recommendation notes usually call for deeper ditches. The main objections to deep ditches are that they are generally unsightly and at some places dangerous, requiring the erection of guard rail, but these objections can be overcome by using a flat slope of, say, one vertical to four horizontal into the ditch. This also has the advantage of throwing the ditch away from the pavement as it grows deeper, where an independent ditch grade becomes necessary.

In general, all ditches should be paved on grades of over five per cent., as this will prevent washing and scouring. It is important that excavation for drainage should be executed with as much care as is the excavation for any other part of the work. Flat ditch grades should always be established at least every twenty-five feet with a level, and a grading line should also be used in connection therewith.

As the earth shoulder on the highway usually builds up, due to the dirt washed from the center of the pavement, it has been our practice to make the slope for the first half a little steeper than that finally required, both in the cuts and on the fills.

The one great fault on shoulder work has generally been that the fill shoulders have been left too high, depending upon a future shrinkage, which is never wholly realized. This is

due to the material washed from the pavement onto the shoulder during rains, and on account of the sod growing up.

The longitudinal grade on any highway should never be level if it can possibly be avoided. This is especially true for the macadam type of construction. For brick or concrete pavement, I do not think it is as important, for they hold their crowns on account of the nature of the material used in the construction of the pavement.

A surface crown of one-fourth inch per foot, which is the minimum used in New York State, is equivalent to approximately a two per cent. grade. In order to get as quick a run-off in the ditches as on the surface of the pavement, it would be necessary to provide at least a ditch grade of this amount, namely, one-fourth inch per foot. In a great many cases, this cannot be done, but it shows the importance of getting as much as possible, and a good reason for extra deep and wide ditches where there is a relatively small profile grade. It is our policy to run independent ditch grades on all profile grades less than three-tenths of one per cent., and to use a ditch grade of not less than five-tenths of one per cent. wherever possible.

In locating the center line of a highway on side hill work, avoid wherever possible the cutting down of seasoned steep side slopes. These are usually the source of much trouble due to sub-surface water which causes slides. However, good alignment should not be sacrificed, nor should grades be lost sight of in order to do this. There are a great many cases where it can be done, nevertheless, with very good results.

The location of the new grade line to the present profile is closely related to good drainage, and in many cases where cuts are made into hills to reduce grades, you will find that you will get a bad drainage condition. To avoid this, the designer should first establish the rate of his maximum grade for any given highway, and having this known, he should follow along the present profile as much as possible, using the maximum grade as the limit. I do not mean by this that one should go to extremes and chop the grade line all to pieces, but one should get the smoothest possible grade with these conditions in mind.

On highways paved with brick or concrete, where there is a car track alongside, I think that it is the best practice to pitch the crown away from the track. In the macadam type of construction, this is not good practice, owing to the inability of this type of roadway to hold a crown, and, if possible, the grade line should be held high enough so that the highway will not get any surface drainage from the track. In both cases, however, a shallow ditch should be constructed between the track and the pavement, for traffic safety, and frequent openings should be provided under the track to take the surface water away and finally dispose of it as soon as possible.

### UNDER DRAINAGE

We now come to the question of sub-surface or under drainage. The under drainage on our State highways is taken care of by using four-inch to six-inch porous or vitrified clay tile underdrains, a foundation course of field, quarry stone, or run-of-bank gravel, or a combination of any of the above. Telford is only used in extreme cases where extra heavy foundation is necessary.

Underdrains are usually located under the side ditches, on the shoulder, or directly under the pavement itself. The depth of the trench is usually from two and one-half to three feet, depending upon the soil conditions, and of sufficient width, top and bottom, to allow for practical excavation.

A layer of fine stone or gravel should first be laid in the trench to regulate the grade of the underdrain, and also to prevent mining in soft soils. The tile should then be laid on this foundation, and the joints should be carefully wrapped with burlap, this wrapping done in such a manner as to get the double lap on the top of the tile. The drain should then be topped off with broken stone or gravel to at least six inches from the top. A layer of impervious material, usually a sod turned over, with an earth back-fill, is then placed on top to prevent surface water from entering and destroying the efficiency of the underdrain.

On the location of underdrains, I want to particularly emphasize the following:

1. They should not be located under the side ditches where you have a road breaking over a hill and where the side slopes are flat or sloping away from the highway. Underdrains, in cases of this kind, if they are necessary, should be located directly under the pavement. They should be at intervals of about twenty-five feet, depending upon the conditions, running from the center line to the side ditches.

2. The outlet ends of underdrains should be extended wherever practical into the culvert side walls. If this is not possible, it should be carried to the ditch and finished with a small concrete headwall and apron.

The following is the description of the treatment of a bad drainage condition on a road built in Erie County, New York, in 1908:

The road was located in a valley with side hill drainage where the soil had very little bearing power. It was decided to keep up the grade by using a foundation course of bank gravel twelve inches thick, together with a four-inch porous tile underdrain on the up-hill side. In this particular case, the tile had to be laid on boards placed longitudinally in the ditch to prevent mining and to keep a good grade.

The trench was filled to the top with No. 4 stone, the idea being to let in the surface water so that it would act as a cleaner for the drain tile. This particular tile drainage system was still in good condition on the occasion of a recent inspection made by the writer, and the pavement is in perfectly good condition to-day after about eight years of use.

Another bad drainage condition was successfully treated with underdrains on a highway in a cut on an eight per cent. grade with side slopes which were quicksand. The type of construction in this particular case was water-bound macadam with a five-inch broken-stone base course and a three-inch top course. The paved surface was sixteen feet wide. On account of the depth of the excavation, it was decided to use a twenty-two foot roadway with brick gutters next to the macadam. The slopes had to be cut back to a slope of one vertical to two horizontal, on account of the soil conditions. Outside of the gutters a small retaining wall four feet high, twelve inches wide on top, and eighteen inches wide at the base, was built to prevent the unstable side slopes from filling the gutters or heaving them out of shape by sliding pressure. On the back of the wall was laid a six-inch porous tile drain, topped off with broken stone to within six inches of the top. Sod was then laid on top with the necessary back-fill of earth, which kept any appreciable amount of surface water from entering.

To take care of any seepage that might follow along the center line of the highway, the up-hill wall of all cross culverts was provided with weepers and back-filled with porous material. This construction has now been in operation for eight years, and has proven so successful for this very bad condition that we have provided the same kind of treatment for two other similar cases in the same vicinity.

### FOUNDATION COURSES

The object of under drainage is to keep the subgrade as dry as possible at all times and to thus increase its bearing power. To attain this result, I am of the opinion that a foundation course of gravel, field or quarry stone, is more effective than any other kind of under drainage.

If there is to be a choice of either underdrains or foundation course, I say to choose the latter, as you will nearly always get better results. For very bad soil conditions, it will almost invariably be economy in the end to use both. The depth of foundations courses usually runs from six to eighteen inches, depending upon the conditions that are encountered. However, no fixed rule can be established, as local conditions must be used as a guide and met for each particular case.

A foundation course eight inches thick and sixteen feet wide can be constructed in most cases where local material is found in the vicinity of the road, for about the same price as could two lines of six-inch underdrains properly built.

The choice of the foundation course to use is governed to a great extent by the local materials that are available. Under certain conditions, good gravel will make a good foundation course, but when it is used, it should be clean and should contain enough sand to just slightly more than fill the voids. If dirty gravel is used in foundation course work, trouble will invariably result, as it will draw moisture by capillary attraction, and after the frost works in, it will be porous and wet

For this reason, therefore, it is not recommended for a foundation course under expensive surfacing and pavements.

Field or quarry stone should be used wherever it is available on account of the better bearing the larger stone will give. An ideal foundation course for use on highway work, and one which has proved itself especially adapted for use under concrete pavements, is constructed in accordance with the following directions:

After the necessary excavation has been made and thorough drainage is provided for, a layer of from two to four inches of fine gravel is spread over the bottom. On this layer of gravel, a course of field stone of the required thickness, depending upon the conditions, is laid. The voids should then be filled with a clean sand or gravel, and the whole course should be thoroughly compacted. After this consolidation has been completed, a layer of about two inches of coarse sand should be spread on the top. This last mentioned layer of sand serves the double purpose of regulating the subgrade and also as a cushion to take the impact from the pavement proper.

In some very bad quicksand holes on a macadam road built in western New York State in 1908, a plank grillage had to be used under the foundation course in order to properly spread the load and to prevent miring.

### CULVERTS

In order to provide cross drainage, our policy in New York State is to use concrete wherever possible. Cast iron pipe is used only where there is insufficient head room, or as a ditch crossing on intersecting highways. Cast iron pipe, when used, should never be less than sixteen inches in diameter, as the smaller sizes clog up very easily, and are usually frozen up at the very time that drainage is most necessary.

Culverts should always be located directly on the line of the stream to provide quick run-off, otherwise the water will accumulate and flood at times. It is best to take the water under the road at the point where it first touches the highway, even though it becomes necessary to make a new outlet channel, for it must always be borne in mind that quick drainage is absolutely necessary to be effective in protecting the road surface.

Culverts on steep grades should be skewed to the center of the road, and the down-hill side wall on the inlet end should be lengthened across the ditch to turn the water into the opening. The desired size of the culvert is usually determined by the size of the present structure, together with a field inspection of the locality in question. Information should in every case be sought from the neighboring residents and the town superintendent as to how the existing structure has handled the water. It is usually the practice to slightly increase the size.

A concrete culvert two feet square on the inside is the smallest size generally constructed by us on the State highways. This size has been selected on account of the convenience in cleaning rather than for its discharging capacity. Properly constructed culverts should have a fall of at least six inches across the roadway whenever this is possible.

In New York State, we lengthen the culverts to the full width of the highway, and by doing so have eliminated the necessity of constructing guard rail, as we have found that we can, by so doing, keep down the maintenance costs of the latter item.

The inverts of all culverts should be low enough, if possible, to drain any swales along the highway. This is important for the reason that these low places usually pond up during the spring run-off, and if they are not drained off the water will soon soak into the highway and impair the life of the wearing surface.

In order to drain the roadway proper on long grades, where there are no water courses crossing the highway, it is the aim to place a culvert at least every eight hundred feet. To do this, it frequently becomes necessary to provide a new outlet ditch. If this is impossible, deep and wide ditches should be constructed.

In long, low stretches where cross drainage cannot be obtained, a heavy foundation course should always be considered.

The inlet and outlet ends of all culverts should in all cases be paved with cobble or concrete, as this will materially assist in keeping them free and open.

Where concrete is used in culvert construction, only the best materials should go into the concrete. It is poor economy to use local materials unless they are clean and of a good quality, as more money is wasted in trying to take advantage of available local materials for concrete construction, when such materials are wholly unfitted for use, than in probably any other way. All materials that are used in concrete construction for culverts, or in fact for any other kind of concrete work, should be thoroughly tested as to their quality.

### PREPARATION OF SUBGRADES

Under the subject of the preparation of subgrades, it is my intention to discuss the same in general for all types of construction, for the reason that the primary requirement of any subgrade is that it shall, at all times, be uniform and dense, so that it will not settle unevenly.

Many road experts believe that where concrete is used, it is not necessary to use the same care on account of the ability of the concrete to act as a slab to bridge over the soft spots in the subgrade. This is a mistake, however, and every possible care should be taken in preparing the subgrade for the different types of construction.

To obtain a good subgrade, our specifications provide that all muck, quicksand, soft clay, and spongy material which will not consolidate under the roller, shall be removed. The depth is determined upon the conditions as met in each specific case. All defective places are refilled with acceptable materials from the excavations or with stone or gravel, where necessary, as a foundation course.

After the necessary drainage has been provided, the subgrade is then to be thoroughly rolled and compacted with a self-propelled roller weighing at least ten tons. Water puddling is only resorted to in case the soil requires it. Care should always be taken so as not to roll the clay foundation too much on account of the danger of developing a plastic condition, which is very undesirable. During the rolling, all hollows and depressions which develop are immediately filled with acceptable material and rerolled. This process of filling and rolling is then repeated until no further depressions occur. In places where the character of the material makes the use of a ten-ton roller impracticable, a lighter one may be permitted to obtain the desired results.

The shoulders must be rolled and left in a compact and satisfactory condition at the completion of the pavement.

Embankment should always be formed of suitable material. If it is formed of stone, reasonable precautions must be taken to insure a solid embankment. The upper surface of the embankment should be rolled and left in a satisfactory condition, approximately true to line and grade. Large stone should not project within six inches of the finished subgrade, and all hollows and depressions should be filled with the smaller stone from the excavation, with gravel, or other acceptable material. Stone in embankment should not be used nearer than six inches to the surface of the shoulders.

Where filling is less than two feet in depth, all vegetable matter should be removed from the original surface. Where necessitated by the existing slope, the original surface should be trenched or otherwise broken up before placing new embankment.

Embankment should be constructed in successive horizontal layers not exceeding twelve inches in thickness. When concrete is to be placed thereon, the layers must not exceed six inches in thickness. Each layer must extend across the entire fill, and each layer should be thoroughly rolled and compacted by approved methods. If impracticable to use a heavy roller for this work, a grooved horse-drawn roller weighing about two tons should be used. Our subgrade embankments in New York State in the past have been faulty due to lack of rolling.

Embankment should always be shaped to drain the surface water as soon as possible.

There are frequently places in embankment work where it is impracticable to use any type of roller, and in such cases the consolidation should be brought about by teaming over it. In cases of such a character, the embankment should be formed as early in the construction as possible, so as to give time for it to settle and become compacted.

On heavy embankments and in places in doubt as to the subgrade, it is our practice to reinforce cement concrete pavements and also the cement concrete foundation of other pavements. This can be done at very little additional cost, and it

aids materially in reducing the number of cracks that will later appear. Before concrete foundation or concrete pavement is placed, the subgrade should always be thoroughly wet down. This is most important, and particularly if the ground is dry or if the soil comprising the subgrade is of a sandy nature.

In brick pavement construction, weepers should be provided in the edgings at the low points in the grade. This allows the water to run off the foundation quickly, and is especially important to drain the water from the pavement after a rainstorm and before the cement grout filler has been applied.

In the design of the drainage system of any highway, it is necessary that a survey be made by walking over it, carefully noting and inspecting all drainage conditions. The best time to do this is in the spring at the time of the heaviest run-off, and after the new grade line has been approximately fixed.

We learn a great deal from experience, and one should take advantage of every opportunity to investigate, and to investigate thoroughly, any drainage system that has been designed and installed to take care of certain conditions, and particularly of unusual and difficult conditions.

The engineer or road superintendent, or both, should always inform himself as to how the road is holding up under the traffic which it bears, particular attention being given to such inspections in places of the kind referred to above, under difficult conditions.

In conclusion, I will say that, while probably everybody connected with the construction and maintenance of highways is more or less familiar with the fundamental principles of drainage, there are a great many cases which will come up which will have to be met by the ingenuity and the ability of the engineer and the road superintendent, and it is problems of this kind that should in all cases be discussed later by all interested. Such discussions as to the details and the relating of experiences of those in charge of such work, will always result in securing better and more permanent construction.

* * *

## Ethics of Contracting

### By A. D. Williams, Chief Road Engineer of West Virginia

IN MANY sections of the country, distrust has permeated the public mind relative to the honesty of the official bodies, boards, and commissions. Quite frequently, in public places, one can hear remarks conveying expressions of doubt in the integrity of officials. This is due in many instances to the methods or systems used in awarding contracts, or public lettings. The larger and more respectable contractors, such as should be invited into public lettings, often refrain from entering a bid, because they do not desire to resort to questionable methods to obtain favors over their competitors. The public often suffers by reason of work being awarded at more than it should cost, owing to the lack of competition.

A public contract should be awarded only in a public manner. The advertisement should state clearly what was expected to be contracted. Plans and specifications should be prepared and furnished so as to acquaint all prospective bidders with every possible detail of the work in question. When the bids are received and opened, each bid should be given due consideration by the engineer and board of commissioners. The conditions contractors desire to have considered should be set forth in a letter accompanying his proposal. After bids are tabulated, each contractor should be given the privilege of looking over and understanding the reasons for the tabulation. Explanation of bids, and proposals not conforming to the specifications and plans, should not be permitted or considered, and if permitted and considered, all statements should be in public in the presence of all other bidders. People should be fully informed as to the bids received and the reasons for the awarding. Executive sessions and assemblages behind closed doors for explanations by any bidder should not be permitted, because these methods have led to much dissatisfaction and have brought upon the officials criticism that has done much toward producing the lack of confidence found in many sections. The man who hopes to win a bid by employing various influential citizens in the community, and so-called expert economists, may not intentionally be doing so, but is adding to the already established distrust in the public mind, because he is expected to shirk the work. The promotion of highway work, and the better highways throughout the country, can only be fostered and perpetuated by the establishment of a high standard on the part of engineer, commissioner, and contractor, so as to build in the public consciousness a confidence that will support the movement. The development of our highways is dependent upon a high standard of ethics being practiced by engineers, commissioners, and contractors.

* * *

## Report of Road Work in Minnesota

Complete reports of proposed road work in Minnesota for the season of 1916 have not been prepared, but reports from sixty-nine of the eighty-six counties show the following amounts of road work:

| | |
|---|---|
| Grading | 1,560.56 miles |
| Gravelling | 564.95 miles |
| Concrete culverts | 1,463 |
| Estimated cost of above | $1,787,936.36 |

The balance of State aid work will be in the same proportion, or approximately as follows:

| | |
|---|---|
| Grading | 1,945 miles |
| Gravelling | 705 miles |
| Concrete culverts | 1,823 |
| Estimated cost | $2,228,500.00 |
| Maintenance 12,000 miles | $600,000.00 |

The policy of the Minnesota Highway Commission is to provide a complete system of maintenance over the whole mileage of State roads and to improve by bringing to permanent grade line and by surfacing with gravel or other surfacing material as much of this system as possible each year. Near some of the larger centers of population it is found necessary to provide a more lasting surface than gravel, on account of the excessive cost of maintenance due to motor-vehicle traffic; but in general this class of construction meets with better satisfaction as it provides an all-weather surface at comparatively low cost and therefore allows for more mileage of improvement.

The State road system covers all of the main roads in the State and its maintenance is quite a problem. The value of any road organization may be gauged largely by its ability to maintain travel over the important lines and this branch of work is given particular attention in Minnesota. We do not consider that the term "maintenance" means only the upkeep of finished roads, but believe that the maintenance funds should be used for maintaining the whole road in passable condition.

While most of the counties in this State are carrying their work along under current tax levies, several have bonded and are making very substantial improvements of their road systems. Even in such counties the policy is to build gravel roads, although we will build five or six miles of concrete road in Winona County, which has a $500,000 bond issue for this year.

We have just completed our report of State aid road construction for 1915, which gives the following amount of work in which State aid is paid:

| | | | |
|---|---|---|---|
| Clearing and grubbing | 682.6 | acres | $ 29,141.55 |
| Turnpiking | 378.25 | miles | 101,569.30 |
| Grading | 546 | miles | 625,425.93 |
| Gravelling | 361 | miles | 299,865.82 |
| Surfacing | 60 | miles | 70,929.28 |
| Concrete culverts, 785 | 21,460 | lin. ft. | 83,561.26 |
| Corrugated metal culverts | 57,029 | lin. ft. | 53,078.34 |
| Bridges, 106 | total length, 4,489 | ft. | 188,451.33 |
| Miscellaneous, guard rails, etc | | | 17,298.74 |
| Total construction | | | 1,469,821.55 |
| Maintenance, 9,983 miles | | | 463,883.88 |

This does not represent all of the work on State Roads, but is practically seventy-five per cent. of the same.

We have just made up a map showing the conditions of the State roads in Minnesota and it might be interesting to note that, of the 12,300 miles of State road designated, there are 1,414 miles brought to permanent grade of standard twenty-four feet width, with a first-class surfacing of gravel, macadam, or concrete. There are 785 miles of road gravelled, which is not to standard, and 2,590 miles were graded to final grade line and standard width, which have not yet been gravelled.




THE ENTERING WEDGE

## Railroad Laid Hard Road

### New York Central used Concrete for Pavement leading to its West Albany, N. Y., Shops; Economy and Durability the Governing Factors

Do the railroads believe in hard roads? Evidence says "yes."

A railroad can increase its traffic by providing good pavements around its passenger stations and freight yards, for, other things being equal, passenger traffic goes to the railroad whose stations are conveniently located and comfortable of access, and freight traffic to the one whose freight houses and house tracks may be reached with the greatest loads.

Railroads also know the direct relation between maintenance of way charges and earnings. And, like the adoption of creosoted ties and heavier rails, the use of a hard road where traffic is heavy lessens the maintenance charges and increases earnings.

Such reasoning undoubtedly prompted the New York Central Railroad to repave the street leading to its West Albany (N. Y.) shops. The old road was of cinders on a clay soil—a common and inexpensive type for a railroad to build—but heavy auto trucks and heavily loaded wagons cut it up so badly that to keep it in passable shape meant endless expense. Hence the concrete pavement shown in the accompanying illustration.



Concrete Pavement leading to West Albany, N. Y., Shops of New York Central Railroad. Built by New York Central Railroad.

The pavement is 2,800 feet long, ten feet wide, six inches thick at the sides and seven and one-half inches in the center, and was laid directly on the old road material, the top surface of which was removed. The use of a mixture of one part cement, two parts sand, and three parts stone demonstrates the foresightedness of the engineer in selecting a proportion rich enough to give the good result. Expansion joints were placed twenty-five feet apart and filled with one-fourth inch of tar paper. After finishing with a wood float, the concrete was cured by covering it with wet earth. One hundred and fifty feet of the pavement is on an eight per cent. grade. The design was made by the company's engineers and work done by force account.

This pavement is now in its third year and the picture is evidence of its good service as well as pleasing appearance—quite in harmony with the well-kept fences and right of way, the big modern locomotive and the substantial-looking factory building in the background.

Railroads have been pioneers and large users of concrete in all forms of construction—bridges, retaining walls, viaducts, foundations, etc., and this latest use was only to be expected. There are many places for concrete paving around railroad stations, such as subway approaches, industry track driveways, station platforms, and driveways leading to freight and passenger depots.

Another instance of permanent paving work to be done by a railroad company is found in Springfield, Ill., where the Chicago & Alton Railroad, through assistant engineer L. V. Manspeaker, has submitted the proposition to pave Third Street on both sides of its right of way from Washington to Adams streets. The type of paving has not yet been selected, but the plan outlined to Commissioner Hamilton and city engineer Wade D. Seeley, of Springfield, calls for one of the permanent types.

* * *

## Kentucky

### Fayette County's Methods

FAYETTE COUNTY, Kentucky, is establishing remarkable records in road improvement and setting a pace which few counties can hope to equal. Efficiency, aggressiveness, and modern equipment have ended a half century of what seems to have been a state of lethargy compared to what has been accomplished in the present era of intensive highway development.

The heart of Kentucky's far-famed blue-grass country, the world's greatest loose-leaf tobacco region and a section rich in other products, notably thoroughbred horses, all of which Fayette County rightfully boasts, has 385 miles of road and all but five miles have been improved with water-bound macadam.

The county embraces about 370 square miles, with one mile of improved road for every square mile of area; a population of about 56,000, with a mile of improved road for every 145 inhabitants.

The achievements of the present administration form an interesting highway romance. Frank A. Bullock, who as county judge in 1896 wiped out the old toll roads by purchasing them for $352,000, to-day presides as judge of the Fiscal Court with all the roads paid for and the county practically out of debt.

Two years ago, when the present county engineer, Robert W. Davis, entered office, the county did not own as much road equipment as a wheelbarrow or a shovel. All county work



Fig. 1. Fayette County's Central Distribution Plant.

was then done by contract. Engineer Davis, abolishing a custom almost traditional for fifty years, built up the facilities and the organization necessary for the county to do its own work, designed a centrally located supply station of 400 tons capacity, employing a gravity system in handling material from freight cars to roadway, built liquid asphalt reservoirs to store 24,000 gallons, with steam heating equipment, erected a warehouse for storing machinery, cement, etc., and purchased the following road equipment: one Good Roads truck for hauling road material and pulling road machinery; one liquid-asphalt distributor for surface-treating roads, two 4-yard trailers, one elevating grader, one scarifier, two road rollers, two mixers, and a rotary broom.

With this equipment and with an organization of only twenty men, the county reduced the cost of hauling to the remarkable figure of $0.046 per ton mile, rebuilt during the past season 22½ miles of worn-out macadam on seven different roads, hauled 5,882 tons of material, built thirty concrete bridges, laid 8,000 feet of culverts, and distributed 80,000 gallons of liquid asphalt in surface-treating about twenty-five miles of road.

Stone is obtained from thirteen quarries, owned by the county but operated by contractors, supplying a central crusher manned by inmates of the county workhouse. This stone arrives at the county supply station in freight cars which are "spotted" on a siding and unloaded by gravity directly into the new concrete material bins. Each of the eight bins has a capacity of fifty tons and each has two outlets.

When the road truck and trailers appear for a load, a traveling chute, reaching from bin to truck and running on a special track, is pushed along the front of the bins until it comes into position beneath the proper outlet. By pulling a chain which lifts the door of the outlet, the driver can load his truck in a few minutes.

When the truck load is to be discharged, the body is elevated by the power-dumping mechanism and the load is either deposited in a pile or spread to a uniform depth, whichever

the foreman requires, thus completing the gravity system of handling from quarry-car to roadbed.

Even in the handling of liquid asphalt, similarly scientific methods are employed. The same spur tracks that are built atop the material bins also pass above two 12,000-gallon tanks. When a carload of asphalt arrives, it is "spotted" above the storage tanks, connected to the steam heating system, and as soon as the asphalt is heated to a state of fluidity, it is also unloaded by gravity. These storage tanks also have interior steam coils to maintain the asphalt in liquid form and facilitate its transfer to the tank of the truck. The latter is equipped with its own steam heating plant, utilizing the White steam generator and maintaining a temperature of 260 degrees, or higher if necessary. There is also a pump, driven off the transmission of the truck, which forces the asphalt through the distributor and applies it to the surface uniformly and with great penetration.

By taking full advantage of the gravity system and keeping the truck and trailers busy, the county has built roads

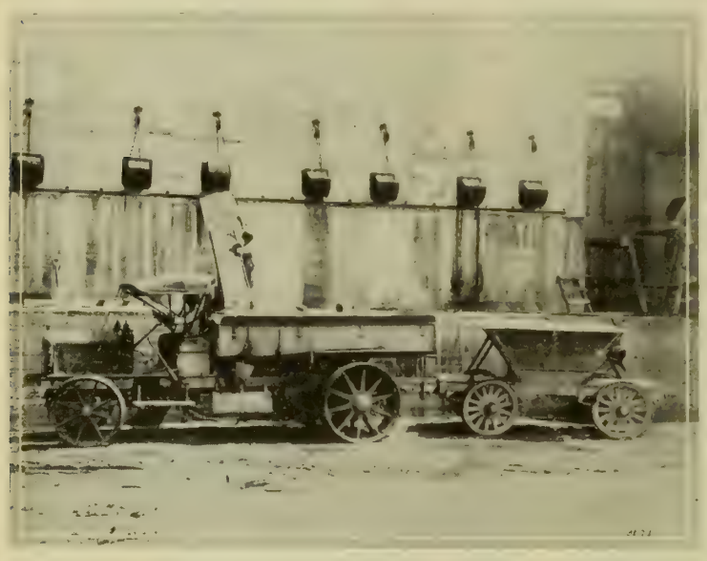


**Fig. 2.—Fayette County, Ky. Loading Truck at Central Distribution Plant.**

faster at less cost. In 120 working days, from May 1 to October 31, 1915, the truck and trailers hauled 5,882 tons of material. This tonnage was hauled at an average rate of nine tons a day for 120 days, the distance being four miles one way. The cost of operation and maintenance was $9.00 per day; $0.184 per ton and $0.046 per ton-mile.

A saving of $43.77 was shown by a typical day's work of the truck and trailers hauling and spreading stone for water-bound macadam construction.

Hauling material is not the only road operation whose cost has been reduced. The truck is frequently used to pull a scarifier. Occasionally it is used to draw an elevating grader as well as the common type of grader.

Quite apart from its usefulness as a road-working machine, was the ability of the truck to haul 300 tons of coal to the county infirmary between periods of other work, saving a considerable sum of money in the cost of the coal delivered.

Fayette County has set an example and established a pace in up-to-date road-building methods that it would be well if other counties would try to emulate.

* * *

## Brick Highways

### By H. Eltinge Breed, First Deputy, New York State Commission of Highways

SO MUCH has been written about brick pavements, their building, the selection of material, and the methods used in their construction, that most of you are doubtless thoroughly familiar with the subject from a theoretical as well as from a practical, standpoint.

I feel safe in saying that, with the exception of a few minor refinements, very few changes have been contemplated during the past two years. Appreciating your familiarity with these conditions, I think it might be most profiitable to tell of the work that I know best along this line; that is, the practices and methods of constructing brick pavements in the State of New York. I will mention such methods as need extra precaution and care; some of the difficulties encountered in sampling and testing; new departures in the form of construction; the number of miles constructed; the average cost per mile; and, in so far as can be given, some data concerning the relative maintenance cost, not exactly of the pavement proper, but of the highway as a whole.

#### PRACTICES AND METHODS

It is not my intention to cover all the features of construction. Instead, I should like to emphasize a few of the features often overlooked, or only perfunctorily considered, which the work of our department has proven to be of fundamental significance in the success of brick pavements. Other features of equal importance I omit because they have received so much general attention.

In the finished pavement, the greatest objection seems to be the longitudinal cracks which appear after the pavement has been down for some time. These appear more often on the highways in the country districts than they do in the city streets where there are curbs, sidewalks, and cut-off drains on both sides of the roadway. This would indicate that on the country highways the cracking comes mostly from a wet subgrade in which there is a certain amount of seepage from the ditches, and is due in the main to subsequent frost action, while in the cities where the whole roadway has a protective covering, there cannot be quite so large an amount of seepage, and therefore we find fewer cracks.

To this end, I should like to emphasize the necessity of adequately draining the subgrade. If we are to build a type of pavement as expensive as brick, the small additional expense needed for drainage is amply justified in comparison with the large initial cost.

It is the opinion of the writer that a sand cushion should not be greater than one inch in depth. This means that the foundation must be uniformly smooth, with the sand cushion acting merely as an evener of the surface. It has been claimed that the sand cushion prevents the crushing of the brick and gives an amount of resiliency that is necessary to a pavement of this type. This statement, however, is not borne out in practice, for I have observed a five-year-old pavement in which a mortar cushion was used that has been bettered by the lack of this so-called resiliency.

Another point to which it has been necessary to give very careful attention is the washing of brick. Many times brick are stored in piles along the road so long in advance of the construction work that they are spattered with mud from passing traffic, and so covered with dust, that it is doubtful whether the grout will properly adhere to them. In all cases of this kind I strongly urge that the brick be thoroughly washed so that the grout will have an opportunity to perform its full function in cementing them together. It is well known that if the grout does not perform this function, the individual bricks become loose and the sand cushion shifts on the absorption of moisture, so that in a short space of time it is badly in need of repairs. A large percentage of the bad results which we discover in our maintenance work is due to the fact that the grouting did not perform its full function by cementing the brick firmly together.

The smoothness of the finished pavement depends largely on the smoothness of the foundation. A little extra care in this respect will amply repay any contractor. Longitudinal expansion joints should be in place before the brick are laid. Good transverse alignment is essential. It is pleasing to the æsthetic sense, it gives a workmanlike look to the job, and the curves are more easily worked out, if the courses are straight. Every few courses should be straightened by lightly driving the rows to place with a sledge on a three-by-four-inch timber, three feet long, laid in front of the brick.

Bats less than three inches should not be used. If necessary, trim the second brick to accomplish this. The bats should be obtained from bricks culled from the pavement, and as every brick is worth from three to four cents each in the pavement, the selection of bats from the culls should be made so that the good half can be saved. This is an element of fairness to manufacturers which all engineers will appreciate.

Never roll a brick pavement on a wet cushion.

In order properly to grout a brick pavement, the bricks should be thoroughly sprinkled first. Great care should be given to the thorough mixing of the grout—sand, cement, and water—first dry and then to a plastic consistency, and then gradually thin out until the mixture just reaches the consistency which will flow. In this manner we are assured of getting the best results. Grout should be applied as soon as mixed, and from mixing to application should be constantly agitated to avoid segregation. Two applications of grout are necessary. The first should merely fill the joints and the surplus should be swept in with rattan brooms. Just as soon as the first grout has settled and before the initial set can take place, a second application, of slightly thicker grout, should be spread, which should be squeegeed as soon as it is slightly settled, working the squeegee over the bricks at an angle with the joints and leaving them filled flush. In our work we are allowing the contractor to use one part of cement to two parts of sand where they use some form of grout machine. Where they mix by hand in boxes we require them to furnish grout with one part of cement to one part of sand.

### SAND

Many bad results in brick pavements can be directly attributed to the use of poor sands. The inconsistency of present-day practice is shown by testing the cement and brick both with a fine degree of engineering precision, and trusting the other material, sand, to visual guess work.

Three different and distinct kinds of sand are used in brick pavements: concrete sand, cushion sand, and grout sand. Concrete sand should be clean and should have at least eighty per cent. of the strength of Ottawa sand in compression. Its gradation should be as follows:

100 per cent. passing the ¼ inch.
85 per cent. passing the No. 6 mesh.
60 per cent. passing the No. 20 mesh.
25 per cent. passing the No. 50 mesh.

A variation of not over five per cent. from these figures should be allowed. Sand with over eight per cent. of loam should be rejected. These may seem to be rigid specifications, but if a foundation is to serve its purpose, it should be strong enough to sustain the pavement with the minimum amount of cracking.

Cushion sand should be of such a nature that one hundred per cent. will pass a number six screen and it should contain not more than twenty per cent. of loam.

Grout sand should be clean and of such a nature that it will have 100 per cent passing a No. 6 screen, and not more than 85 per cent. passing a No. 20 screen, 30 per cent. passing a No. 50 screen, 5 per cent. passing a No. 100 screen, and it should be rejected if it contains more than five per cent of loam.

### DIFFICULTIES ENCOUNTERED IN SAMPLING AND TESTING

Many of the shale block being used to-day show great differences in color produced by different grades of burning. Sometimes there are as many as four or five different shades. In sampling, the department has found that this fact, properly considered, is a valuable aid for the determination in the laboratory of what block may be rejected, and for the information of the inspector in the field when the final culling in the pavement takes place, and especially so because there is an observable relation between the shades of color produced by burning and the results of the rattler test. We have, therefore, instructed our men to choose samples according to the different colors and textures, and to keep duplicate samples of the same shade and texture to be a good guide to the selection and rejection of the poor brick when the results are determined from the laboratory tests, for any person thoroughly familiar with a given brand of brick and the results of the rattler test on the different shades will be able to cull accurately by visual inspection. This does not apply to all classes of block, for many of them are practically of a uniform range of color. But I know of a number of cases in which it has been of very valuable aid in enabling us to get results procurable in no other way.

It has been suggested at various times, both by manufacturers and by some engineers, that it might be advisable to test brick at the plant. The writer has given this subject careful consideration, and it seems to him that the present practice of sampling and testing brick in the field insures better results than testing at the plant, for the following reasons:

Brick are not manufactured uniformly in the same sense that cement or asphalts are manufactured as uniform products.

Long experience with a given brand is necessary before the brick can be accurately culled by visual inspection.

The men best fitted to cull brick by visual inspection are the employees of the brick company which manufactures the brick.

The sampling from the different benches of the kiln to show the variations in burning can be done more accurately by the burner than by an inspector.

Variation in temperature in different parts of the kiln give different qualities of brick. These can be assorted and selected best by the men who burn them.

Factory inspection of brick places the responsibility of uniform shipments of acceptable brick on the inspector, and offers an opportunity to the brick company to dispose of cull brick because of their lack of responsibility in the selection.

During the past year this department tested 269 lots of brick, comprising 22 different brands, and representing a total of 27,000,000 brick; 13.6 per cent. of these failed to meet the specifications and were rejected. This does not include the amount culled by the inspectors and rejected on the work, which, in some cases, is rather large. With brick tested at the plant, it seems to the writer that our chances for getting good material would decrease, for if the manufacturers were willing to take such a long chance with a large outlay of freight and handling involved, they would certainly be willing to give inferior material at the plant and would load some brick from the kiln which would not be good enough to go into the work.

### NEW DEPARTURE IN THE FORM OF CONSTRUCTION

During the past few years, two types of new construction have been advocated, one known as the monolithic form, in which the brick are made an integral part of the foundation, and the other the mortar cushion type. Both these have many advantages according to claims of their advocates. It is the intention of our department this year to try some brick laid with the mortar cushion, and it is our intention in building this type to use some three and some three and one-half inch brick in order to gain economy in the saving of freight charges and handling. It has the advantage of closely approximating this monolithic form of construction and so gives added strength to the pavement. Another advantage of it is that there can be no failures from swelling or shrinking of the cushion sand, and should the pavement crack, only the crack will be affected, and not the whole structure as is the case when a sand cushion is used.

### NUMBER OF MILES CONSTRUCTED AND THE AVERAGE COST PER MILE

Up to January 1, 1916, New York State has completed 238 miles of brick pavements. These different pavements are of varying age, and I will later tell briefly of the cost of maintaining them.

The average cost for brick pavement on five-inch concrete pavement is, per mile of sixteen to twenty-six foot roadway, $25,750.00. The average cost per square yard of pavement is only $2.015. These figures were obtained from an average of twenty-three highways.

In order to get a comprehensive cost of other types of highways in New York State, I will also present figures on water-bound macadam, bituminous macadam, and cement concrete.

*Water-bound Macadam.*—Cost per mile of sixteen to twenty-six foot highway, $10,250; cost per square yard of pavement only, $0.648. The cost per square yard was obtained from 434 values and the cost per mile from 419 values.

*Bituminous Macadam.*—Cost per mile of sixteen to twenty-six foot highway, $12,970; cost per square yard of pavement only, $0.871. Both of these items were obtained from the average of 134 highways.

*Cement Concrete Six Inches Thick.*—Cost per mile of sixteen to twenty-six foot highway, $15,320; cost per square yard of pavement only, $1.121. Both of these items were obtained from an average of 20 highways.

It will be noted that the difference between the pavement cost and the total cost of the highway lies, in all cases except brick, between four and five thousand dollars. The reason why the cost of items other than pavement is apparently high on

brick roads, lies in the fact that the cost of edging has been excluded from the pavement cost, and included in the total cost.

It may be interesting to note that up to January 1, 1915, there have been built in the State of New York, 5,167.19 miles of all kinds of highways. During 1915, this department built 1,083.35 miles, making a total of 6,250.54 miles of road. At the present time, there are 783.05 miles under contract which are not completed.

RELATIVE MAINTENANCE COST OF THE WHOLE ROADWAY

The maintenance charge for 238 miles of brick for the year 1915 was $41,840, or approximately $176 per mile per year. This amount was increased to a large extent by a number of our older pavements which had many replacements. If we eliminate those, we find that we would have 107.91 miles of brick pavement which cost $14,185 to maintain and repair. This is at a cost of approximately $131 per mile. These figures, as I mentioned at first, are not the figures from the pavement alone, but they include such treatment as cleaning ditches, cost of patrol where patrol was needed, fixing up the shoulders which are cut up by the turning out of traffic, the cleaning up of slides, and maintaining guard rail. From observation, I think it would be safe to say that about thirty to forty per cent. of this cost is the average cost which would cover the maintenance of the pavement alone, although in some cases for a series of years there is practically no cost to the pavement proper.

With these figures it may be interesting to note the cost of maintenance of other types of pavement during the same year and computed on the same basis as that for the brick roads, that is, including the maintenance of guard rail, shoulders, ditches, patrol, etc., as well as the surfacing.

For gravel, we find that it cost $577 per mile for 192 miles of road. For water-bound macadam, we find that it cost $564 per mile for 2,298 miles of road. For penetration method bituminous macadam, we find that it cost $448 per mile for 2,387 miles of road. For bituminous macadam, mixed method, it cost $181 per mile for 63 miles of road. For second-class concrete roads requiring surface treatment, it cost $532 per mile for 295 miles of road. For Portland cement concrete pavement, 1 : 1½ : 3 mix, it cost $129 per mile for 84 miles of road.

The best results are obtained in brick pavements, as in all other engineering works, by strict adherence to details of workmanship and rigid inspection. In any engineering work, or in any work of importance and of a contractural nature, inspection is necessary because it is human nature to get as much out of any situation as is possible. Even where contractors are perfectly honest and put all the materials called for into the work, doing it to the best of their ability, it often fails or gives results not commensurate with its cost. This is probably shown to greater extent in highway construction because it presents so many new and different types of construction of which the men on the ground may have but little knowledge. Rigid inspection should be given on all construction work, and one man at least on every piece of work should have adequate knowledge of the type of pavement to be constructed. He should be selected by virtue of his knowledge of this type and of general constructural work, always keeping in mind the personal equation of the man under consideration in respect to his ability to carry out and complete the work in hand. Where inspectors of this kind are not to be had, they should be trained, and only those who are proficient and do good work should be kept in this capacity, for the ultimate result is mainly dependent on them.

In conclusion, it is the opinion of the writer that, while many good brick pavements have been built, there is still much room for improvement in this branch of highway engineering work, and in reaching out for any betterments that are possible, it is hoped that some of the suggestions presented in this article may be of help.

* * *

## Culverts and Flood Damage

IN MANY portions of the country, highways are subject from time to time to very severe damage from floods and freshets. A long section of earth road is sometimes completely abolished by the raging waters of a stream, which, swollen by heavy rains or melting snows, is carrying destruction far beyond its normal banks. On higher class thoroughfares, expensive surfaces of macadam, concrete, or brick are sometimes undermined and torn to pieces by freshets. At other points, huge deposits of mud or sand are left upon the finished surface of the roadway.

There is no doubt, however, that the most serious damage is in relation to bridges and culverts. During floods like those which recently swept the vicinity of San Diego, California, and the terrible visitation in the Miami Valley in Ohio in the spring of 1913, bridges, not only of the obsolete wooden type, but of steel, concrete, and stone are completely demolished.

The losses in connection with bridges of these types are so huge as to seem to dwarf by comparison that caused by the washing out of a culvert or short-span waterway. It is probably true, however, that the sum total of the losses caused by culvert failures under flood stresses, is fully equal to that



involved in the more spectacular destruction of the great steel and concrete bridges. These last must be replaced as soon and as permanently as possible, but it is often the case that the gaping holes left in country roads at the intersections of the smaller waterways must for a long time await the accumulation of funds for their lasting repair, in the meanwhile being bridged with planks or some other makeshift material.

It will, therefore, be of interest to road builders everywhere to note the successful resistance to flood damage which is shown by corrugated pipe when used as culverts. Figures 1 and 2 are photographs of corrugated culverts installed in Madera County, California, several years ago, and show their condition after the severe freshets of 1914. Although the roadway had been torn away by the waters, the strength and resiliency of the pipe enabled it to perfectly withstand the conditions, and it was only necessary to replace the fill and the broken bulkheads to completely restore the road at these points.



We have the following story on the authority of a corrugated pipe salesman. Driving past a big ranch, managed by an acquaintance of his, he noticed a corrugated pipe culvert under the driveway. His curiosity was immediately aroused, and he forthwith called on the manager and asked where he got this particular pipe.

"Out in the middle of that two hundred acre field yonder," was the reply.

"In the middle of a field?" said the salesman. "How did it come to be there?"

"Don't know definitely," said the ranchman, "but have my suspicions that it washed out of the county road a mile or so

above last winter. I needed a culvert, and believe in taking the good that is set before me and asking no questions."

We have always had our doubts as to the one hundred per cent. veracity of the story of the Kansas farmer who needed a piano for his daughter, and couldn't afford it, but had one sent from heaven through the medium of a typical Kansas cyclone which deposited the piano in his front yard, undamaged; but corrugated pipe is considerably tougher, and knowing of its behavior in many localities, are inclined to accept our friend's story at its face value.

A very notable instance of the ability of corrugated pipe to withstand the hardest kind of attacks of this sort, as well as



**Fig. 3. Armco Iron Twin Culverts installed near the Miami River in Butler County, Ohio, in 1907. The road over them has been washed away by floods *three times* since they were put in place, but they are still apparently as good as new.**

the ordinary action of the elements, is illustrated in Figure 3. These twin culverts were installed in the fall of 1907 under a road which runs for a long distance very near to the Miami River, which stream has an unenviable fame as the origin of sudden and destructive floods. On three separate occasions the road has been washed away above and around these culverts. This photograph depicts the remains of a brick pavement which was laid only last summer at this point on a substantial concrete foundation. Of course, when the gravel was washed away from underneath, the pavement could not do otherwise than collapse. The culverts, however, are found to be practically as good as new—even the galvanizing having been but very slightly affected by seven years of exposure and hard luck.

Corrugated pipe may not be perfectly adapted to all locations, but its toughness and resiliency and consequent ability to dispense with unyielding foundations, make it a practical recourse in a great many instances.

* * *

## Accomplishments of the Philadelphia Bureau of Highways

### By William H. Connell, Philadelphia, Pa.

NO ONE will dispute the fact that well-paved streets and roads are a credit to a municipality and one of its principal show cases, and is it not a fact that there is no better drawing-car for business establishments than a fine window display? This being the case, why should not a municipality avail itself of the opportunity afforded with respect to its pavements which represent the goods in the window, and which are the avenues of approach to all municipal and private enterprises in the city? Poor pavements result in untidy streets, and leave visitors with the same unpleasant recollection that they would have of a carelessly managed household or business establishment. We like everything about us to be spick and span, and we form a great many of our impressions through surface appearances; consequently, in these days when automobiles are no longer a luxury since they have been so reduced in price as to be within the reach of families of moderate means, there is no better way to advertise a municipality than through the medium of good roads and pavements, and, is not such a reputation one of the greatest assets of a municipality?

Although through the advent of the automobile the demand for improved pavements has been more pressing in the past few years, still in Philadelphia it has been one of the principal concerns of the public for over two hundred years.

Prior to 1719, all the streets were unpaved, and numerous complaints were made of their miry and dirty condition, a situation prevailing in all American cities at that time. However, during that year, some of the foot pavements were paved with bricks and the cartways with stone, and about this time the minutes of the city council state that, as some of the citizens had voluntarily paved some of the portions of the streets with pebbles, an ordinance should be passed to restrain the weights of loaded carriages passing over them.

The first street in Philadelphia that was regularly paved was Second Street, between Market Street, which was then called High Street, and Chestnut Street. As the city grew, the need of proper pavements began to be felt more and more, and, in 1750, the grand jury represented the need of paved streets so as to remedy "the extreme dirtiness and miry state of the streets." Nothing much was done until 1761, when the city of Philadelphia raised $50,000 by means of a lottery (then a favorite method for raising funds), and some of the money was used to pay for the paving of Second Street, from Market to Race Street. The pavement was what was called in those days pebbles, to-day known as cobble pavement. Curb stones were first laid in Water Street, from Market Street to Arch Street, about 1786. The systematic cleaning of our streets may be said to date from 1765, "when a scavenger was appointed to supervise the cleaning of the streets once a week."



WILLIAM H. CONNELL
**Chief of Bureau of Highways of the Department of Public Works of the City of Philadelphia.**

"Scavenger" was the title in those days for the superintendent of street cleaning.

For the sake of preserving the pavements, the authorities in 1767 required drays to have tires four inches wide, as they found from experience that heavy loads carried on narrow tires damaged the paving.

Wood block paving was first laid in Philadelphia about 1835, Walnut Street east of Third Street having been one of the first streets so paved, and about that time considerable experimentation was done in this kind of paving, various shapes, sizes, and kinds of blocks being tried, but with very little success, due to the poor foundation and to the lack of proper methods of the preparation of the wood. At that time, it was found that the life of a wood block pavement was only about three years, although some lasted a year or two longer. The wood block paving laid in Chestnut Street between Fourth and Fifth Streets, in 1845, was replaced in about three years by squared stone blocks, about eight inches deep and about ten inches square, laid by the rectangular system. About this time, some stone pavements were built with the blocks laid diagonally, the blocks being laid at an angle of forty-five de-

grees. The idea was that the joints would not work so much under traffic with the blocks in this position.

Concrete as a pavement foundation was opposed in a report of a committee of the Franklin Institute, published in 1843, on the ground that it represented "a barrier against the necessary access to the underground works of a city," the idea being that one of the desirable points of a pavement was that it could be readily taken up to make repairs to underground structures.

Nothing typifies the advance that our city has made within the past thirty-five years more than the improvement in our pavements. In 1884 we had about 535 miles of paved streets, with a yardage of over 9,700,000, and 93 per cent. were paved with cobble, whereas now the cobble is less than three-tenths of one per cent., there being only 5.69 miles with a yardage of 57,752. At that time our asphalt pavements constituted only one-third of one per cent. of the total, whereas now they constitute 49.7 per cent. of the total mileage.

The Philadelphia Chamber of Commerce is now carrying on an extensive campaign to advertise and bring business to this city, and since this will result in drawing hundreds of thousands of visitors, all of whom will have occasion to be on the streets for a part of each day during their stay, one of the principal things that will influence their impressions of the city will be the condition of the roads and pavements. The value of a good, well-kept pavement is not only a money asset to the abutting property and the municipality, but its advertising value is an added asset, and a poor pavement is nothing short of a burden.

Now that the city is entering into an ambitious program for the development of a rapid system, increased port facilities, and a sewage disposal plant, all of which will make Philadelphia a more desirable place in which to live and will result in increasing the population, and with it the traffic on our streets and roads, it is important that they should be kept in first-class condition. This being the case, the accomplishment of this result from an economic standpoint resolves itself into a problem in upkeep. We have assets of the city under the care of the Highway Bureau in streets, roads, bridges, and sewers representing a value of approximately $115,000,000, and failure to attend to the upkeep means depreciating this asset. One of the principal secrets of success in business corporations and industrial establishments is the upkeep of the plant, and this is likewise the most important consideration, in so far as our highways are concerned.

In other words, the application of the theory that "a stitch in time saves nine" to the roads and pavements is the most important single factor in connection with the physical work coming under the jurisdiction of a highway department. Not only will failure to repair all slight defects result in a great financial loss to the city through the increased cost of repairs necessitated through this neglect, but let us consider what ruts and holes in our streets and roads mean to automobiles and vehicles of all classes in cost of renewal of broken springs and the wear and tear brought about as a result of this condition. A conservative estimate of the cost per vehicle for renewal of parts and ordinary wear and tear caused through being compelled to travel over poor pavements would be at least forty dollars a year per vehicle, and when we consider that in a city like Philadelphia there are approximately thirty thousand vehicles of all classes on the streets every day, neglect to properly attend to the upkeep of the pavements would cost automobilists and business concerns operating all kinds of vehicles approximately $1,500,000 per year.

This brings us face to face with the importance of this problem, which through the increase in traffic each year is becoming more and more serious, all of which simply means that we must attend to the maintenance of our roads and pavements. Upkeep is an all-year-'round problem with the Highway Bureau, and consisted of the replacement, repair, and cleaning of 1,655.74 miles of streets and roads at a cost of $3,867,594.26 during the year 1915, and adding this to the cost of the newly constructed pavements, the maintenance of sewers, snow removal, and miscellaneous work coming under the jurisdiction of the Bureau, it involved an expenditure of $6,003,632.91 for the year, and the expenditure for all classes of work for the past four years amounting to $21,523,685.35. This work involved a multiplicity of operations, the contracts alone averaging 500 per year, or 2,000 in four years, and necessitated, in order to carry this work on in an economic and satisfactory manner, a thorough systematizing of the operations, and indicates to some extent the necessity for simplifying as far as possible the work of the department.

PLANNING BOARDS

In an endeavor to define some means of insuring a more thorough and intimate knowledge of the status of the operations coming under the jurisdiction of a large highway department than that afforded through the up-to-date records and definite procedures for each operation, it became evident that it would be necessary to supplement these records and procedures with planning boards containing a graphic representation of the status of the operations in such a manner that the work could be more readily controlled than is the case where it is necessary to constantly refer to office records. No matter how thoroughly the operations of a highway department may be systematized, where the heads of the different units of the organization are dependent upon daily consultations and studies of the records on file to enable them to picture in their minds the status of the work under their jurisdiction, there is always a certain amount of lost motion and unbalancing of the work, resulting in one locality receiving undue consideration at the expense of the another, or delays in the starting of important contracts due to unconsciously yielding to outside influences interested in pushing forward less important work. This new scheme for controlling the work of a department through visualizing the operations enables the executive and division heads to at any time obtain a picture of the status of the operations coming under their respective jurisdiction, and is the most up-to-date system heretofore employed in highway departments or industrial corporations to simplify carrying on the work in an orderly and systematic manner.

(*To be continued in June.*)

* * *

## More Oiled Earth Construction in Illinois

During 1915, Cass County, which lies in the black dirt belt of central Illinois, oiled thirty-four miles of earth road. As considerable care was taken in the construction, a brief description of the methods and machinery employed will be of interest to those contemplating similar work this year.

The first work consisted in shaping up the road, cleaning out the old ditches and constructing new ones where necessary, and removing all sod and vegetation from the surface of the roadway between ditches. Machinery used in grading the road consisted of an "Uncle Jim" Road Leveler, manufactured by the Brezee Manufacturing Company, Mattoon, Illinois, drawn by a 30 H. P. International Harvester Gas Tractor. The operation of these machines is shown in Figure 1.

After the road was shaped up to the proper crown, it was compacted with a road roller weighing fifteen tons. This



rolling was very thorough, in the words of the commissioners, until the surface was as "hard as paving brick."

Road oil Nos. 5 and 6 of the Standard Oil Company of Indiana was used exclusively. Supplied in tank cars, it was pumped into tank wagons by a small Fairbanks-Morse steam

pump. From six to eight minutes were required to fill the 600-gallon capacity Etnyre road oiler used.

Other equipment consisted of a 30 H. P. steam boiler and a Farquhar oil tank heater.

The oil was applied hot at the rate of 4,000 gallons per mile of road for a width of twenty feet—a little more than one-



third gallon per square yard. Two applications were made, twenty-four hours apart, two thousand gallons used in each. Traffic was kept off the road for sixty hours after the last application.

Care was taken to see that no dust was on the road when the oil was applied. Light sprinkling was resorted to at times when there was a coating of dust on the road likely to prevent the oil from penetrating properly.

A few roads in sandy sections of the county had had some clay mixed with the natural soil, forming a sand-clay surface. On such roads three applications of oil were made, each of two thousand gallons per mile. About thirty-six hours elapsed between the second and third applications.

Oiling was not discontinued for the season until well into November. Thus far indications show that the best results are obtained when the oiling is done in summer. Some stretches of road oiled in November began to cut up under traffic when similar stretches oiled in September were still in excellent condition.

Plans for 1916 call for the re-oiling of the 34 miles of 1915 construction with one application of from 2,500 to 3,000 gallons per mile. On 40 miles of new work it is planned to use between 4,000 and 6,000 gallons in two or more applications, more than ordinarily used last year. Six thousand gallons per mile amounts to approximately one-half gallon per square yard.

County Commissioners of Cass County are George F. Kuhlman, Beardstown, Ill., Robert Louden, and William Roegge.

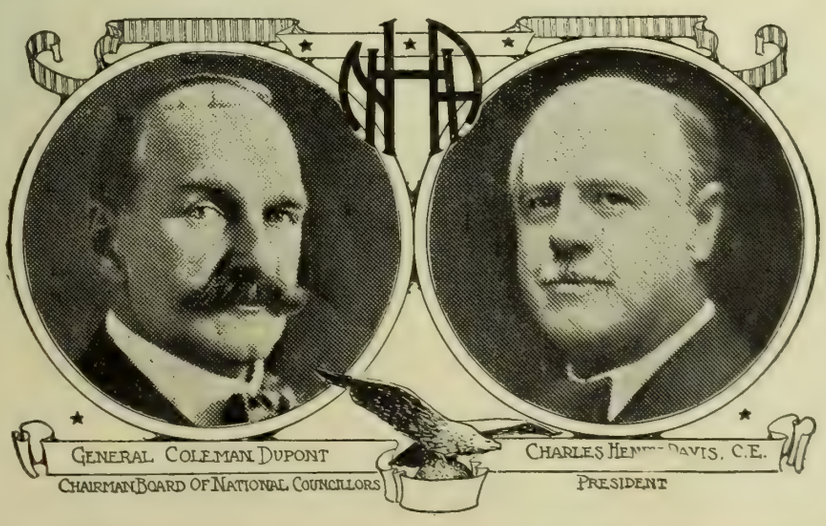
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The American Tar Products Company, Chicago, Illinois, announce that another new plant will be put up shortly at Steubenville, Ohio. Crude tar will be obtained from the La Belle Iron Works.

# OFFER $2600 IN PRIZES FOR GOOD ROADS PHOTOGRAPHS

## National Highways Association Announces Photo Contest Open to Everybody. Want Pictures to Start Exhibit In National Capital to Show Law Makers What Uncle Sam Should Do in the Good Roads Movement

## COLONEL THEODORE ROOSEVELT, IDA TARBELL AND MARK SULLIVAN TO SERVE AS JUDGES IN CONTEST




**OFFICERS OF NATIONAL HIGHWAYS ASSOCIATION WHO SUBSCRIBED FUNDS TO CARRY ON PHOTOGRAPHIC CONTEST**

A nation-wide photographic contest in the interest of the "Good Roads Everywhere" movement, with cash prizes of $2,600 open to everybody, has been announced by the National Highways Association.

Colonel Theodore Roosevelt and the two well-known writers, Miss Ida Tarbell and Mr. Mark Sullivan, will serve as judges in the contest.

### PURPOSE OF THE CONTEST

The photographs selected in the competition will be used to establish in Washington a national exhibit on the good roads problem designed primarily to promote a nationally conceived scheme of highways.

### PRIZES TO BE AWARDED

The cash prizes of $2,600 were subscribed by General Coleman du Pont, Chairman of the Board of National Councillors, and Charles Henry Davis, President of the National Highways Association. The competition will be known as the du Pont-Davis Road Photograph Prize Contest.

The competition will be kept open for eight months, closing at noon, Tuesday, November 7. All photographs should be addressed to "Good Roads Everywhere" Photograph Contest, National Highways Association, Washington, D. C.

# Twenty-One of Miami's Principal Streets Paved with Topeka Mix

## General Description, Asphalt Plant, Contractor's Methods

MANY features combined to make interesting the most southerly job of asphaltic paving of any consequence in the United States, namely, that at Miami, Florida, finished late in 1915.

Permanently paved streets in that city were few up till a year ago, at which time a comprehensive system of improvements was decided upon and a prominent municipal engineer, Mr. B. H. Klyce, Assoc. Mem. Am. Soc. C. E., of Nashville, Tenn., called to take charge of the work. Extensive sewer construction followed by the paving of practically all of the important streets of the city with asphaltic concrete, were done by one large contracting firm, F. G. & A. C. Proudfoot, of Chicago, Ill.



Fig. 1. Excavating trench for sewer through solid coral rock. Thirteenth Street.

The paving of each street was let as a separate contract, there being twenty-one in all. The total amount of work approximated 55,000 square yards. Subsequently the same contractor put in 25,000 square yards of pavement, making about 80,000 in all, but this article will be confined to a description of the earlier work.

On nine of the streets Standard Mexican Asphalt was used, supplied by the Standard Oil Co. of New Jersey; on the remaining twelve, Bermudez Lake Asphalt of the Barber Asphalt Paving Co.

### SEWER WORK

Some interesting features of the sewer construction will be mentioned in brief:

Six miles of sewers were constructed during 1915, the larger ones of reinforced concrete rectangular in section, and the smaller of vitrified tile pipe.



Fig. 2. Building the concrete sewers. Note the use of the big boom and bucket paving mixer which allows concrete to be deposited at point required without rehandling. Eighth Street.

Excavation was all through solid coral rock, depths ranging from six to twelve feet.

Diameters of the largest concrete sewers were, vertical, 4½ feet; horizontal, 4 feet. The tile pipe sewers ranged in size from eight to twenty inches in diameter.

Concrete for all of the sewer work was of a 1:2½:4 mix, reinforced. A Koehring No. 22 mixer (paving type, capacity 17 cubic feet of mixed materials per batch) was used.

### PAVEMENT DESIGN

Specifications for the pavement followed the standard of the American Society of Municipal Improvements.

The subgrade was excellent, being the old coral macadam pavement, four inches thick. This rock has excellent binding qualities and, though soft and unsuited to use as the wearing surface for streets or highways carrying any considerable traffic, it makes an ideal foundation for more permanent types of wearing surface.



Fig. 3. Koehring Paver laying concrete base on southern terminus of the Dixie Highway.

Practically all of the pavements laid prior to 1915 had been placed directly on this macadam without a concrete foundation, but in 1915 work, because the old stone had been cut up considerably in the sewer construction and also because it was, in many places, of indifferent construction, it was decided to lay a concrete foundation.

The old macadam having been scarified, shaped to the proper section, and rolled, four inches of 1:3:5 concrete was

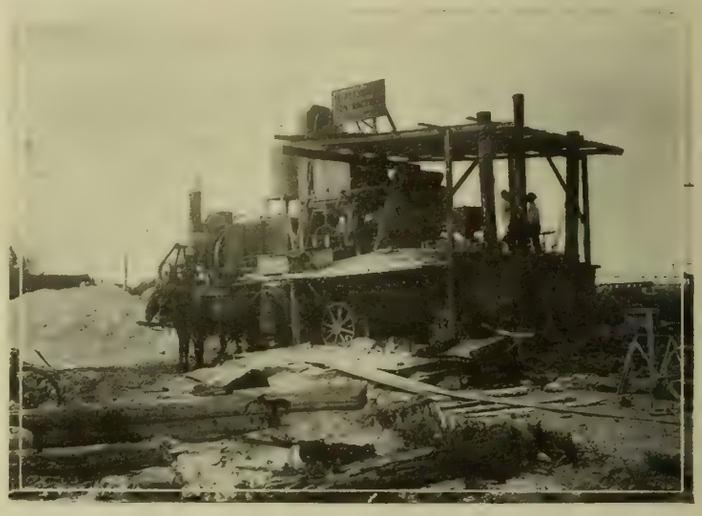


Fig. 4. The contractor's 750-yard Cummer road asphalt plant. Three melting kettles in foreground, right mixer and asphalt wagon drawn by mules, left. Aggregates brought in by railroad spur and stored in pile seen at extreme left. Tank cars of asphalt at right, behind kettles.

placed, using the Koehring No. 22 paver mentioned above. Saylor Portland cement was used throughout the work. The local coral rock being unsuited to cement work, coarse aggregate had to be shipped in by rail from Ojus, forty miles north. This Ojus rock (as it is called) is Miami oolitic limestone, sometimes erroneously called coral and coraline rock. It is quite porous but tests by the Pittsburgh Testing Laboratories showed very high crushing strength. It answered the purpose

well. Fine aggregate consisted of sand dredged from Biscayne Bay.

A week was allowed between placing the foundation and the wearing surface. All of the streets were provided with 18-inch concrete combined curb and gutter of the ordinary design.

ASPHALT PLANT

The contractor's asphalt plant was a 750-yard capacity road plant manufactured by the F. D. Cummer & Son Co., Cleveland, Ohio. Designed, as all such plants are to use coal for fuel, the contractor equipped it with oil burners, both to run the engine and to heat the materials. Fuel oil was quite cheap in Florida and other Gulf States last year, averaging around 3½ cents, and its use for this work effected a large saving over the cost of using coal.



**Fig. 5. Laying binder on Avenue C on January 10, 1916, near the finish of the second contract. On this street car line strip is paved with brick.**

The plant was set up at a railroad siding at a distance from the work which made the haul average one mile. Figure 4 shows the plant in operation. With long experience in all kinds of paving work, the contractor so handled the operation of the plant that its average output was largely in excess of its rated capacity, being close to 1,000 yards per nine-hour day. The maximum day was about 1,700 yards—more than double the rated output for a ten-hour day.

RAN PLANT AT NIGHT

One factor making for this large yardage lay in running the dryer continuously day and night. The working day during which paving operations were carried on was nine hours. The standard working day in Florida is ten hours—the sewer,



**Fig. 6. Tenth Street looking East toward Biscayne Bay, showing finished pavement**

grading, and concrete gangs worked this length of time—but for laying "hot stuff" during the hot Florida summer, nine hours was about the maximum that the men could stand and do good work.

At the end of paving operations each day, the hot material from the dryer, instead of being carried up the hot elevator into the bins, was run out onto the ground, forming a large pile near the foot of the elevator. With the air near the dryer at a temperature of from 90 to 104 degrees, little heat was lost from the pile, even if the material remained on the ground for several days, which was not often the case. Ordinarily the whole night's output of hot aggregate was used on the following day together with the daytime output of the dryer. The effect of this was to nearly triple the capacity of the plant, in so far as the heating of the aggregate was concerned.

To obtain good stone for the mix, the contractor was obliged to go nearly 700 miles—to Chattanooga, Tenn., where an excellent hard limestone, locally known as Bluestone, is quarried. Limestone dust was shipped in from a slightly nearer point, Atlanta, Ga., about 500 miles distant.

Labor also came from a distance—Mobile, Ala. All common laborers were negroes.

WEARING SURFACE

Mixing, hauling, and laying the Topeka Mix were carried on in a similar manner to the ordinary paving job of like character. Kelly-Springfield five- and eight-ton tandem rollers were used to compact the material. Surface was tested with a ten-foot straight-edge and all depressions of more than 1-16 inch were rolled out.



**Fig. 7. Finished pavement on Avenue A; Standard Mexican Asphalt used. Contractor F. G. Proudfoot, in light suit, is shown standing on sidewalk at left.**

The streets varied in width from thirty to sixty feet, the widest being the celebrated Biscayne Bay Boulevard, paralleling the ocean shore in a wide crescent. Incidentally, this boulevard forms the southern terminus of the Dixie Highway.

The length of time taken to complete the entire 55,000 yards was a few days under five months. As before stated, the contractors were F. G. & A. C. Proudfoot, of Chicago, Ill. A. C. Proudfoot was in direct charge of construction. Testing of all materials was done by the Pittsburgh Testing Laboratories.

* * *

## Jaw vs. Gyratory

### Some Factors Governing the Selection of Type

THE invention of the stone crusher in the year 1858 by Eli Whitney Blake of New Haven, Connecticut, marked an epoch in road making. After more than fifty years, during which time practically all of the modern types of pavement, with the single exception of water-bound macadam, have been invented or brought into any extensive use, the stone crusher remains, in many ways, the most important piece of machinery used in the industry.

Crushed stone (or crushed gravel) forms an essential part of practically every type of pavement, it is used as the aggregate for concrete pavements, for practically all kinds of bituminous pavements, and in the concrete or broken stone base for brick, wood, and stone block pavements.

But in addition to the old Blake jaw crusher, which to-day is manufactured along practically the same lines as the original invention, with improvements and refinements rather than any radical changes in design, there is now the newer gyratory machine, brought out in the early '90's and first manufactured by the Allis Chalmers Co., of Milwaukee. This type has many joints of superiority over the jaw; yet each has its field and it is the purpose of this article briefly to outline the conditions affecting a choice between the two types of machine.

The large gyratory is the logical choice for commercial plants. Several reasons follow:

1. Larger capacity, because it crushes continuously while the jaw crushes only one-half the time, on the closing stroke.

2. For equal capacity, the gyratory takes less power because of its continuous motion while, with the other machine, on each stroke the swinging jaw starts from a state of rest.

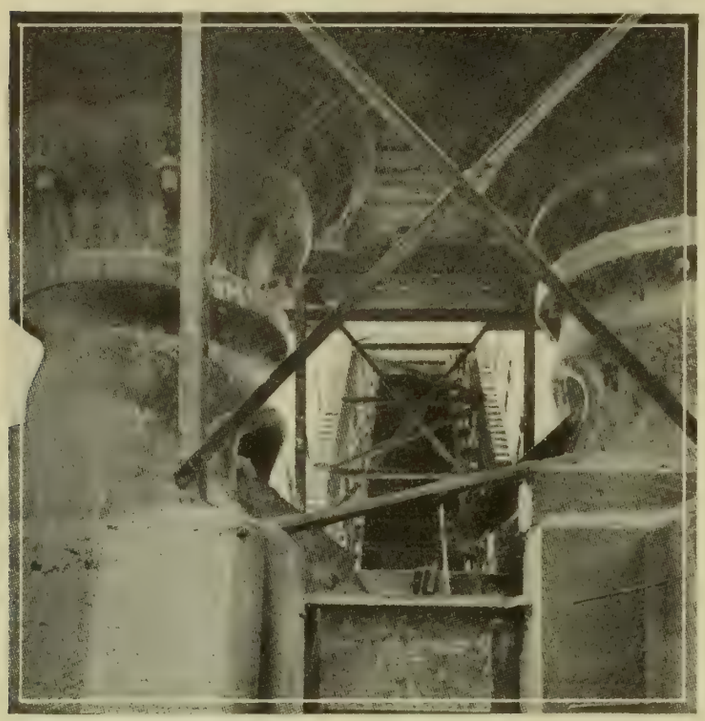


**Fig. 1. No. 8 McCully and No. 7½ Austin Gyratories side by side at the Chicago Portland Cement Company Plant.**

3. Because the full strength of the crushing stroke must be developed in a half revolution of the eccentric shaft, large fly wheels are necessary in the jaw type. The tremendous momentum of such fly wheels is likely to cause breakage if iron gets into the machine.

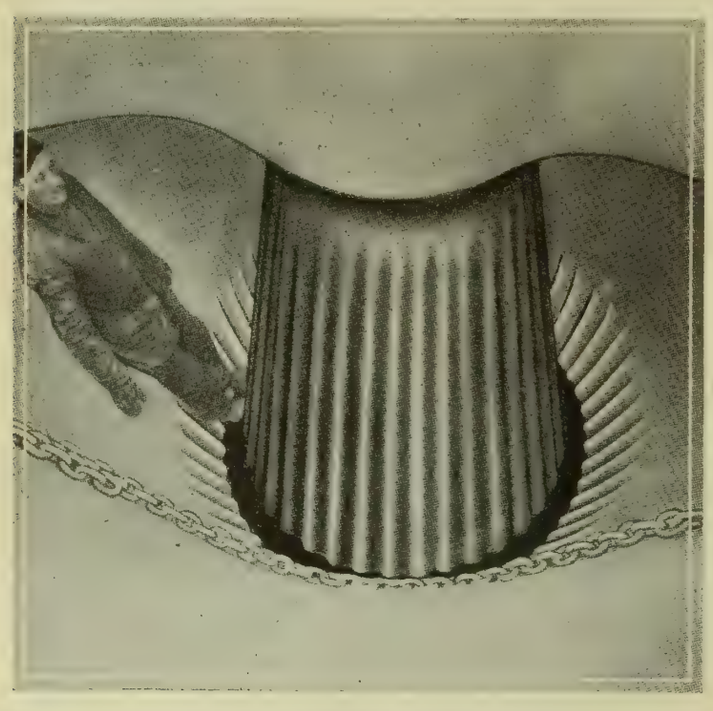


**Fig. 2. View looking into 42-inch McCully Mammoth Gyratory Crusher at the plant of the Chicago Portland Cement Co., Oglesby, Il**
Courtesy of the Power & Mining Machinery Co., Milwaukee, Wis.

4. The long, straight discharge opening of the jaw machine causes more "slabbing" than the curved opening of the gyratory. This is important in preparing stone for road building, where uniform stones, cubical in shape, are much preferred.

5. A jaw crusher has smaller crushing surfaces subject to concentrated wear, consequently repairs are more frequent and costly.

6. The gyratory creates less dust in crushing.

7. A gyratory generally is easier to feed. This depends upon the layout of the plant to a great extent, but the hopper

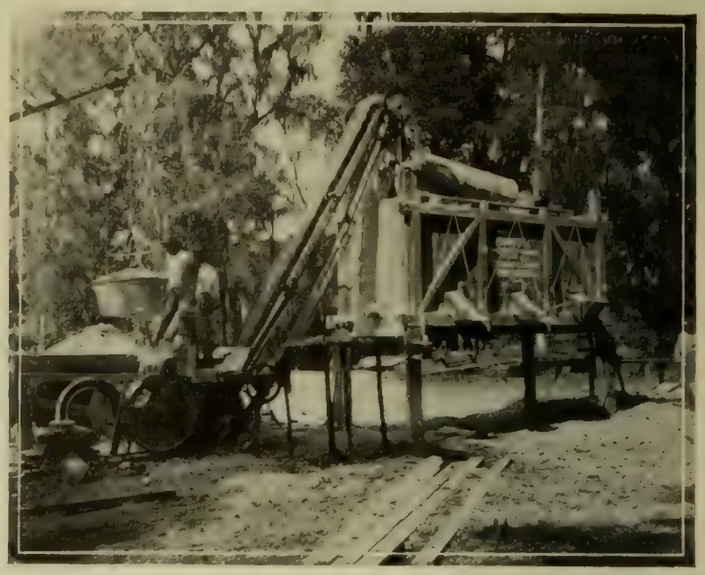


**Fig. 3. Small Smith Jaw Crusher, Elevator and Bins owned by Hernando County, Florida.**
Courtesy of Smith Engineering Works, Milwaukee, Wis.

shaped gyratory usually requires much less shovelling of materials than does the jaw.

8. It is harder to keep the bearings cool on a jaw machine. This is shown by the fact that on most large jaw machines now manufactured the bearings are water-jacketed.

9. There is less wear and tear on the gyratory on account of its continuous motion as distinct from the reciprocating,



**Fig. 4. A Smith Gyratory Crusher with elevator and bins.**
Courtesy of Smith Engineering Works, Milwaukee, Wis.

pounding motion of the jaw. Heavier foundations are required for jaw machines, else the vibration would soon tear the crusher to pieces.

### POINTS IN FAVOR OF THE JAW

The great field for the jaw crusher is in the small portable plant, though small-sized portable gyratories are now being used quite extensively. Substantially the same arguments in favor of the portable gyratory machine hold good as those outlined above, but, to counteract them, the jaw has at least two features especially recommending it to this class of work, namely:

1. Low first cost. Crushers in portable plants are not run as continuously as those in large commercial plants; therefore it may be good business not to tie up so much capital in equipment.

2. Less weight. Though not always the first consideration, ease of haulage should not be lost sight of in the case of



**Fig. 5. Aurora Rock Crusher (jaw) with gravel feeder working in Muskego Township, Waukesha County, Wisconsin.**
Courtesy Austin-Western Road Machinery Co., Chicago.

a portable plant, particularly if it is moved frequently. For equal capacities, the use of a jaw may save anywhere from 2,000 to 6,000 pounds over a gyratory.

Low feed is another feature of the jaw machine. Individual conditions will determine the weight to be given to this factor in a given case.

There are many other special conditions which may determine the selection of type. For example, where large chunks of rock are to be crushed, but where the output of the crusher is to be relatively small, a jam machine is generally the more economical due to its larger opening for machines of equal capacity. Such a condition may arise in a large commercial plant or with a small portable one.

Again, the nature of the material to be crushed may be such as to throw the weight of argument to one type or the



**Fig. 6. Ten-ton Austin Gasoline Roller operating a No. 3 Gyratory Crusher in blue granite rock in Northern Wisconsin near Hurley, Iron County. The outfit belongs to the County Commissioners of Iron County.**
Courtesy Austin-Western Road Machinery Co., Chicago.

other. Some gravels, for example, contain much clay, and the effect of this should be taken into account when determining which kind of machine to buy.

Another factor occasionally bearing on crusher selection is the kind of power available, whether electrical, steam, or gasoline. This phase is too complicated to take up in detail but serves to remind one of the fundamental difference between the operation of the two machines—the one having a reciprocating motion comparable with the ordinary reciprocating steam engine, and the other, a continuous motion comparable with the steam turbine. The jaw depends upon a heavy fly wheel to overcome the inertia of starting and stopping the swinging jaw, while gyratories are run with no fly wheels at all.

# The Relation of Size of Sand Grains to Strength of Mortar and Concrete

Mr. Cloyd N. Chapman, Engineer of Tests, Westinghouse, Church, Kerr & Co., New York City

(*Continued from April Issue*)

True, there are not enough of these tests to establish a law, but they bear out other tests on size of particles which

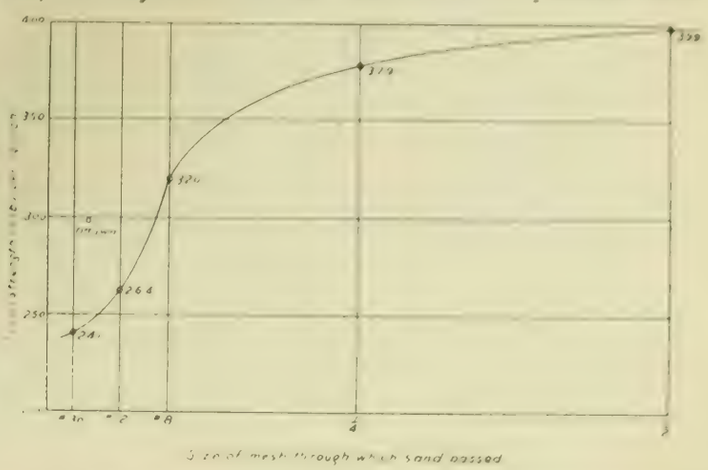


**Fig. 3. Curve showing relative tensile strength of 1:3 Mortars at 28 days due to varying coarseness of sand. Consistency normal.**

will be referred to later, and they are probably indicative of the effect of varying the size of the sand in concrete. It should be noted that these sands are alike in all respects except size. In each case the sand used was the same except that it had been passed through a sieve of the mesh indicated by the abscyssæ of the curve.

These same sands were used to make tensile-strength briquets in the proportion of 1:3 and gave results as shown in Fig. 3. These results argue strongly for coarse sand for concrete but they are obtained with sand which differs very widely in maximum size of grain.

Let us look now at some results obtained with sands which differ chiefly as to the variation in the quantity of the different sized particles which make it up rather than upon the limits of the range of size.

The following examples are taken from the results of tests made in the laboratory of the Public Service Commission in New York City under the direction of Mr. Ralph E. Goodwin.

Three specimens were made for each test and the proportions were 1:3 by weight. The following table gives the general data and results.

TABLE 1.

| | Mechanical Grading per cent. passing Number of sieve | | | | | | | Per cent. of strength of Ottawa sand | |
|---|---|---|---|---|---|---|---|---|---|
| Sand | 4 | 8 | 16 | 20 | 30 | 50 | 100 | 7 ds. | 28 ds. |
| A | 98 | 91 | 67 | .. | 30 | 12 | 4 | 104 | 111 |
| Ottawa | .. | .. | .. | 100 | 00 | .. | .. | 100 | 100 |
| B | 99 | 97 | 85 | .. | 42 | 10 | 2 | 84 | 92 |
| C | 100 | 100 | 99 | .. | 92 | 63 | 25 | 41 | 58 |

It will be noted that all three sands are under four mesh and that none have as much as 10% retained on the eight mesh, but below this size there is quite a marked variation in the size of grains. This is more clearly shown in Fig. 4, which shows the granular metric curves of these sands.

Sand A, as shown in the above table, is somewhat better than standard Ottawa sand, 104% to 111%, and its curve more nearly approaches the parabola shown in Fig. 1 than either of the other two.

Sand B is somewhat weaker than Ottawa sand, 84% to 92% as strong, and a glance at its curve in Fig. 4 will show that it is considerable finer than sand A.

Sand C is the finest of the group and shows a strength of only 41% to 58% of that of Standard Ottawa sand. Its granular metric curve offers a very ready explanation for its low strength, as it shows a sand almost all under thirty mesh and nearly two-thirds of it under fifty mesh. These results are in no way extraordinary and are obtained repeatedly with sands varying, as these do, in their mechanical analysis when other qualities are similar or identical.

One more series of tests in which the only variable was the size of the sand grains, may be of interest. This series was made in the laboratory of Westinghouse, Church, Kerr & Co., in the course of an investigation to determine what mixtures of sands from the same deposit, but previously screened to different sizes, would produce the strongest mortar. The granular metric analysis curves of these sands are shown in Fig. 5. They are designated as X, Y, and Z, and it will be noted that X is the finest, Y is medium, and Z is the coarsest.

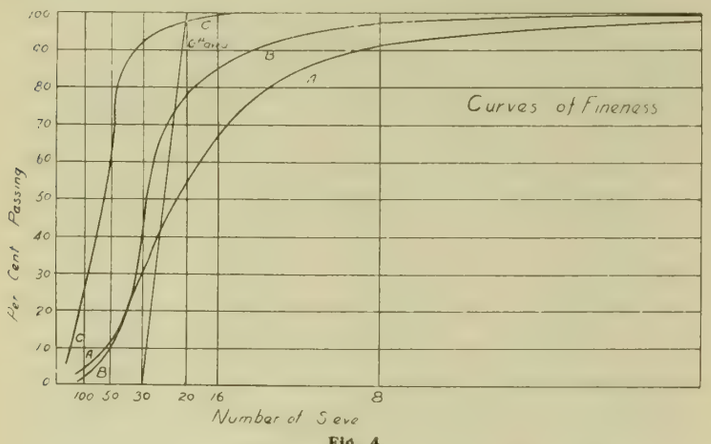



Fig. 4.

The results obtained when these sands were tested in 1:3 mixtures with cement in the form of briquets broken in tension, averaged:

X sand, 86% of standard Ottawa sand.
Y sand, 99% of standard Ottawa sand.
Z sand, 117% of standard Ottawa sand.

These sands were identical as to chemical composition, hardness, surface texture, specific gravity, cleanliness, etc., as they were dredged from a submerged sand bank, thoroughly washed, screened wet to several sizes and then remixed in definite proportions for testing. The results are very closely in line with the other cases cited above.

### CONCLUSION

While the few scattered examples given above are not set forth here as proof of any law, yet they are so typical of a great number of results of sand tests that it seems safe to make a few general statements on the effect of size of sand grain on the strength of mortar and concrete.

1. That a graded sand whose coarse grains are large, say, up to one-fourth inch, produces a stronger mortar and concrete

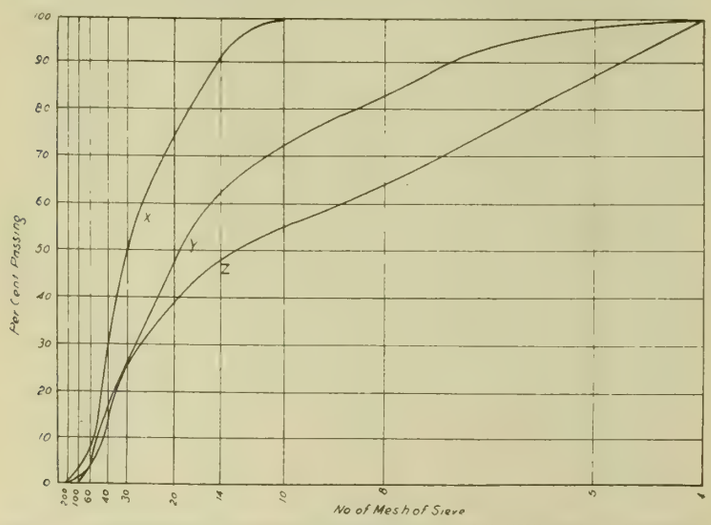



Fig. 5. Granularmetric analysis, curves of sands "X," "Y" and "Z," used in W.C.K. tests.

than a graded sand whose coarse grains are not so large, and the further the size of the coarse particles is reduced, the weaker will be the mortar or concrete.

2. That with the same maximum size of grains, a sand with a large proportion of coarser grains will produce stronger mortars than one with a large proportion of finer grains.

3. That a sand whose granular metric analysis curve conforms reasonably closely to any one of the "Curves of Maximum Density," will produce a better concrete or mortar than one whose curve varies radically from these.

Emphasis may again be laid on the fact that other qualities than size have a very decided effect on the strength of mortar and concrete, and it cannot be assumed with certainty that because one sand is coarser or shows a better size grading than another it will make better or stronger concrete. Some sands of very poor grading make much better concrete than some other sands which are well graded. But, *other things being equal*, a well-graded coarse sand will make the best concrete.

* * *

## Ohio

### Emergency Road Levy Held Legal

A Decision of State-wide Importance Affecting Every County in Ohio Has Just Been Handed Down by Judges Allread, Ferneding, and Kunkle of the Court of Appeals.

A decision affirming the Court of Common Pleas has just been handed down by the Court of Appeals in the suit brought to compel the placing on the tax duplicate of an emergency levy for road purposes under sections 7419 and 5649-4 of the General Code of Ohio. Judge Jones of the Common Pleas Court allowed a writ of mandamus, and the decision of the Court of Appeals sustaining his view of the law is concurred in by all the members of the Court of Appeals—Judges Allread, Ferneding, and Kunkle.

The following statement of the facts is quoted from the decision of the Court of Appeals:

"The County Commissioners of Miami County adopted a resolution finding that certain principal turnpike roads of said county had been so worn by the large amount of travel as to creat a condition causing difficulty, danger, and delay to traffic thereon, and that the ordinary levy authorized by law was inadequate to provide money necessary to repair or rebuild the same, and ordering that a special tax levy under Sections 7419 G. C., of one and one-half mills be made upon the taxable property of the county for the purposes aforesaid. The relator, the board of County Commissioners, sought and obtained a writ of mandamus requiring the county auditor to place said levy upon the tax duplicate regardless of the limitations of the Smith one per cent. law."

After quoting Sections 7419 and 5649-4 of the General Code of Ohio the Court of Appeals announced its decision in the following language:

"The controversy hinges upon the meaning of the word 'emergencies,' as used in Section 5649-4 G. C.

"The plaintiff in error contends that the word 'emergencies' is limited to conditions caused by the sudden unexpected casualities referred to in the first part of Section 7419 G. C., but does not include road conditions caused by ordinary travel or some neglect of the proper authorities to keep the same in repair.

"We think, however, upon a careful construction of the two sections referred to, that Section 5649-4 INCLUDES ROAD DEFECTS ARISING FROM ALL OF THE CAUSES SPECIFIED IN SECTION 7419.

"The General Assembly evidently adopted Section 7419 as a final precaution against bad roads, and was intended to apply where the roads were in such condition as to cause difficulty, danger, or delay to teams passing thereon, and where the ordinary tax levies were insufficient, providing such conditions arose from any of the causes mentioned in that statute.

"Section 5649-4 was enacted to prevent the Smith one per cent. law from interfering with the general scope of Section 7419. Section 5649-4 G. C., is a legislative exception to the Smith one per cent. law.

"The case at bar is distinguishable from the Franklin County case referred to, where this court held that a general resolution of the board of County Commissioners to improve all the roads of a county, without specifically finding as to any road, was not within the purview of the two sections above quoted.

"Here the finding specified and it will be presumed, in the absence of a showing to the contrary, that the roads named in the resolution are the principal turnpike roads in the country and that their condition falls within the scope of Section 7419, General Code.

(*Continued on page* 46)

# Better Roads and Streets

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Subscription Agents Wanted Everywhere. Good Commissions


Boost for good roads and whoop up the boosting.

* * *

And now just keep right on shouting for those better roads we are needing so badly in every direction.

* * *

No single factor plays such an important part in the social and business life of a community as the quality of its roads.

* * *

How many folks will say, "This is the land of the free and the home of the brave," but it is also the land of mud.

* * *

Spring is here and now is the time for us to get busy and push the agitation for good roads.

* * *

As Verdun has proven a barricade to Germany, so have bad roads proven a barricade to civilization in this country.

* * *

While we are simply jogging along, others in other communities are building better roads and reaping the financial results.

* * *

The economic problem of to-day is not so much a problem of production as it is a problem of distribution, and here is where the benefit of an improved road gets into the argument.

* * *

The town or village which neglects its streets or roadways is given a wide berth by the automobilists who are continually going all over the country.

* * *

The Lee Loader Company have completed their new factory at Twenty-fourth and South LaSalle streets, Chicago, Ill., the offices being removed to the same building.

* * *

The Standard Slag Company, formerly of Toledo, Ohio, announces their new address in the Wick Building, Youngstown, Ohio.

* * *

You may have been shouting for better roads but your shouts have been so weak, too feeble, and too half-hearted. Put more vim to it, and tell everybody to insist to everybody else that we need and must have better roads.

* * *

Upon entering the city, you have often read "Speed limit eight miles an hour." It would come nearer telling the truth if it read, "Safety First. The condition of many of our streets will permit your driving only five miles an hour."

* * *

We have all heard about the back-to-the-farm movement, but it is useless to talk to the young man who has forsaken the bad road district and gone to the city, about back-to-the-farm, if back to the farm means back to the old muddy road.

* * *

C. L. Douthett, division engineer of the Vermilion County, Illinois, bond roads, has moved headquarters to Sidell where he will have charge of the construction of the twenty miles of road in Division 8.

* * *

R. M. Barker, city engineer of Greenville, Kentucky, reports that that city will let bids May 2 for the improvement of State aid roads in Greenville, Muhlenberg County, Kentucky. Also 3½ miles of streets.

* * *

The Chicago office and salesrooms of the Goulds Manufacturing Co., Senaca Falls, N. Y., manufacturers of pumping machinery used extensively on road work, have been removed to No. 12 South Clinton St.

* * *

Announcement is made that the name of the Peoria Metal Culvert Co. has been changed to "Peoria Culvert & Manufacturing Co." Building, as they do, a large line of road machines, drags, etc., in addition to corrugated culverts, the latter name is more in harmony with the nature of the business.

* * *

Mr. Charles P. Light, well known among highway officials, engineers, manufacturers and contractors, announces that, beginning May 1, his connection with the American Highway Association as field secretary will cease and he will associate himself with the Fidelity Life Insurance Company of Philadelphia in a managerial capacity.

* * *

Columbia University will hereafter confer the degree of master of science upon graduate engineering students who satisfactorily complete the graduate course in Highway Engineering. From 1911 to 1915, the graduate engineering students who have specialized in highway engineering have been candidates for the degree of master of arts.

* * *

City Engineer Harry A. Perkins, of Leavenworth, Kansas, is making an experiment of turning the bricks on a small patch of pavement, about fifteen feet square, on Delaware Avenue. If successful, doubtless much of the old brick pavement in the city will be repaired in this manner.

* * *

The Indiana Paving Brick & Block Company, Brazil, Indiana, is the latest addition to the family of licensees of the Dunn Wire-Cut Lug Brick Company. The Indiana company has been in business for many years and has a high standing in the paving brick industry. The plant has a daily capacity of about 50,000 pavers and it is equipped with 26 kilns, 30 feet in diameter.

* * *

"Milwaukee County Solves the Highway Problem" is the title to a little folder recently issued by the Merchants' and Manufacturers' Association of the city of Milwaukee. Photographs, a map showing completed and prospective work, and a few pithy paragraphs comparing permanent and impermanent construction, summarize the results of Milwaukee's progressive highway program.

* * *

The annual convention of the Texas Good Roads Association was held at Taylor, Texas, March 16 and 17. The meeting was well attended and many interesting and instructive talks were given. The following officers were elected: W. G. Turner, Fort Worth, president; Howard Bland, Taylor, vice president; D. E. Colp, San Antonio, secretary-treasurer; T. L. Beauchamp, Paris, assistant secretary.

Farmers are vitally interested in tractor and automobile operation. More than one thousand of them attended the recent Tractor Show in Kansas City, and a large number enrolled in the six-day short course in gas engine, tractor, and automobile operation at the University of Wisconsin, Madison, Wis., February 7-12. This interest in tractors and automobiles indicates that there will be an increased demand for permanent road construction.

* * *

Contractors should be provided with sufficient canvas to protect all freshly laid concrete from rain. In placing the canvas care should be taken in making the laps so that the cover will shed water readily. Canvas should be supported well above the freshly finished work. When a portion of the pavement laid has not been floated canvas may be supported on horses in such a way as to permit the finisher to complete his work under shelter.

* * *

Percy H. Wilson, Mem. Am. Soc. C. E., formerly secretary of the Association of American Portland Cement Manufacturers, has opened offices in the Land Title Building, Philadelphia, Pa., where he will engage in consulting practice. Mr. Wilson is a graduate of the civil engineering department of the University of Pennsylvania, and in addition to his notable work with the Cement Association, has had extensive engineering practice, largely in river and harbor work.

* * *

Mr. W. G. Jenkins, for several years manager of the Mixer Department of the Lansing Company, Lansing, Michigan, has resigned from this position and gone into the contractors' supply business in Minneapolis, forming a new company, known as the Minneapolis Equipment Company, 801 Plymouth Building, Minneapolis. In concrete mixers, Mr. Jenkins will handle not only the Lansing line, but that of the Oshkosh Manufacturing Company, Oshkosh, Wis., and the Northwestern Steel and Iron Company, Eau Claire, Wis.

* * *

State Highway Commissioner Clinton Cowen, of Ohio, received bids on April 28, on thirty-four State-aid road contracts. This was the second letting of the year, and was almost as large as the first letting on April 7, when work estimated at $1,391,490.82 was awarded, which provided for the construction of approximately ninety miles of road. The second letting was $1,135,377.85, practically all of which will be completed this year. This work is well distributed among twenty-four counties of the State.

## Commissioner Cunningham of Pennsylvania Died Suddenly

Just as this issue of Better Roads and Streets goes to press, word was received of the death on April 26, of State Highway Commissioner Robert J. Cunningham, of Pennsylvania, at his home in Sewickley, near Pittsburgh, Pennsylvania. Mr. Cunnigham was born at Elizabeth, Allegheny Co., Pennsylvania, in 1860, and received his education in the public schools of that city and at a private academy at Sewickley. Soon after graduation, he took up newspaper work, later specializing in music, upon which subject he was soon recognized as a critic.

Mr. Cunningham was for seven years a member of Sewickley council, and then served as Comptroller of Allegheny County from 1903 to 1906, in which year he was elected to the State Senate. He resigned from the Senate two years later, however, to again become Comptroller of Allegheny County, which office he held continuously until April 13, 1915, when he was appointed State Highway Commissioner of the State by Governor-Elect Martin G. Brumbaugh. Mr. Cunningham is survived by two children, Mrs. Cunningham having died but a few months ago.

* * *

## Thomas J. Keane Dead

Thomas J. Keane, Superintendent of Asphalt Construction of the Pennsylvania State Highway Department, died at his home in Harrisburg, on Wednesday, April 26, of double pneumonia, contracted but four days before. Mr. Keane was one of the best known asphalt authorities in the East, and had been in charge of this class of work for the Pennsylvania State Highway Department since 1912, prior to which time he was in charge of the municipal asphalt repair plants at Pittsburgh.

Two changes in the office addresses of Koehring Machine Company branches have just been made. The Portland, Oregon, office is now at 254 E. Hawthorne Avenue and the Seattle, Washington, office at 1208 Western Avenue. Following the policy of the Koehring Machine Company, both of these branches maintain warehouses in which are kept a complete stock of Koehring mixers and parts ready for immediate delivery. In addition the Koehring Machine Company are distributors for the Northwest of the Sterling Motor Truck and the C. H. & E. Mfg. Company's saw rigs and pumps.

* * *

## To Test Aggregates

Last year, Aberdeen, S. D., constructed a concrete alley in the rear of the City Hall. In order to determine the suitability of local material for paving, the stretch of alley was divided into four sections with imported aggregates in three sections and local material in the fourth section. All sections are standing up so well that no decision has been reached to date. The work was done under the direction of R. B. Easton, city engineer at that time. Frank LeCocq is the present city engineer.

* * *

## Change in Chain Belt Organization

C. W. Levalley, founder of the Chain Belt Company, Milwaukee, Wis., and president and general manager of the concern, has been made chairman of the Board of Directors. Originally manufacturing chain belt for farm implements, the company gradually got into the elevating and conveying machinery business and, for the past nine years, have been large manufacturers of concrete mixers.

Succeeding Mr. Levalley as president is Mr. W. C. Frye, who has been with the company for twenty years and who will retain his position as secretary. Mr. Frye is also connected with several steel manufacturing concerns in Milwaukee and vicinity.

* * *

## Canton Culvert Wins Suit

The Canton Culvert & Silo Co., Canton, Ohio, recently won its appeal in the Court of Appeals of the District of Columbia against the Consolidated Car Heating Co. The latter firm had applied for a trade-mark substantially identical with the "No-Co-Ro" trade-mark registered by the former, and covering high-corrosion-resisting metal. The Court declared that the "appellant was the first to adopt this mark and has established a trade reputation in connection therewith. There was no legitimate reason or excuse for its adoption by appellee (The Consolidated Car Heating Co.) upon this line of goods and we are not disposed to indulge in refinement where such a manifest appropriation appears."

* * *

## McCullough Goes With Cement Association

Ernest McCullough, consulting engineer of Chicago, Ill., and well known among highway engineers as well as in the concrete construction field, has become identified with the Portland Cement Association, Chicago, Ill., as chief engineer of the fireproof construction bureau. He is a graduate of the University of California, class of 1887, and in addition to consulting work is well known as a writer on technical subjects, being author of several books and former editor of *Engineering and Contracting* and the *Railway Age Gazette.* He is a member of the American Society of Civil Engineers, Western Society of Engineers, and other engineering bodies.

Mr. McCullough's headquarters will be at the main offices of the Association, 111 West Washington St., Chicago, Ill.

* * *

Practically every State university in this country has inaugurated a short course in highway engineering; but it remains for Professor James I. Tucker, of the University of Oklahoma, to bring out the first correspondence course in highway instruction. The course covers the many branches of road and bridge construction, and any one passing an examination of the lessons given cannot help but be better equipped in this particular line of work. If the vast army of men, from all walks of life, elected by the people and spending the public's money, could have the advantage of such a course, then our present system of road construction, maintenance, and repair



*Forest Lawn Road, Florence, Neb., showing condition of road before the use of "Tarvia-X"*

# *Before and after——*

BEFORE this road was tarviated it was difficult to keep the surface in decent condition on account of the automobile traffic. The swift thrust of automobile driving wheels disintegrated the surface and the expense of maintaining the road in good repair was large.

When it was resurfaced in June, 1915, the road was bonded with "Tarvia-X."

The Tarvia forms a tough, plastic matrix about the stone, cementing it into a concrete. Automobile wheels instead of destroying the surface will compact it and help to preserve it.

# Tarvia

## *Preserves Roads Prevents Dust–*

The use of the Tarvia added a little to the cost of the resurfacing of the road, but this will soon be repaid in the *reduced cost of maintenance.* This road surface is waterproof and develops no dust or mud.

Scores of communities now are using Tarvia regularly year after year simply for the sake of keeping down road expenses. There are three kinds of Tarvia and a dozen ways of using them to meet various road problems.

*Booklets on request. Address our nearest office.*

*Special Service Department*

This company has a corps of trained engineers and chemists who have given years of study to modern road problems.

The advice of these men may be had for the asking by anyone interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

The Barrett Company

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New York Chicago Philadelphia Boston St. Louis
Cleveland Cincinnati Pittsburgh Detroit Birmingham
Kansas City Minneapolis Salt Lake City Seattle Peoria

THE PATERSON MFG. CO., Limited: Montreal Toronto
Winnipeg Vancouver St. John, N. B. Halifax N. S. Sydney, N. S.



*Forest Lawn Road, showing transformation of road surface after the use of "Tarvia-X"*

would certainly be improved through the information thus received. Of course, it is impossible for county and township officials to become engineers through such a course, but the knowledge of the fundamental principles of road building properly applied would certainly result in the abolishment of a large amount of waste so prevalent under the present conditions.

* * *

## Wayne County Votes Direct Tax

### Will Spend $315,000 for Concrete Roads in 1916

The Wayne County, Mich., Board of Supervisors has voted a direct road tax of $315,000 to continue the work of road building during the 1916 season. Good roads in Wayne County owe their existence largely to the Detroit Board of Commerce which has fathered and backed the movement from its inception. A $2,000,000 bond issue, the expenditure of which was spread over a five-year period, was used to accelerate the work, but this fund has now been exhausted. The Wayne County Board, of which Edward N. Hines is chairman, has built concrete roads almost exclusively. This additional $315,000 was voted by the supervisors after a flood of letters and appeals from business men of Detroit and farmers and produce men living throughout the territory where the roads have not been improved. All of it will be expended on concrete roads in 1916.

* * *

## The American Association of Engineers

### Will hold Annual Convention in Chicago, May 9-10, 1916

The newly formed engineering association will hold its first annual convention May 9-10 at Chicago, at which time several amendments of the constitution will be acted upon. A student membership will be created for the benefit of junior and senior students in engineering. This membership is to cost $3.00 per year, $1.00 of which is to be devoted to the Association publications and $2.00 to promotional work in the student chapter.

All members of the Association are entitled to be delegates to this convention and all engineering societies are cordially invited to send official delegates to assist them in working out some of the commercial problems relative to engineering work which at present confront the engineer. Any plans which will bring the engineer before the public in such a light as to advance the cause of engineering will receive careful consideration.

An informal banquet will be held at the City Club on the evening of the 10th, to which all members and their eligible friends are invited. One new national director and an auditing committee of three members will be elected at this convention.

The association has shown a most remarkable growth, having secured 625 applications for membership since its organization on May 14, 1915. It is growing at the rate of over 100 a month. Its Service Clearing House is placing an average of six men per week in touch with vacant positions. It has at present a greater demand for high-grade engineers than it is able to supply. It reports that the remuneration of engineers is improving and that men are working at the best salaries they have ever received.

* * *

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF AUGUST 24, 1912.

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National Highways Association, Washington, D. C.
Elizabeth Evans, Jamestown, Ohio.

Known bond-holders, mortgagees, and other security holders, holding one per cent. or more of the total amount of bonds, mortgages, or other securities, None.

JESSE TAYLOR, Editor.

Sworn to and subscribed before me this 29th day of March, 1916.

HARRY LIEURANCE,
Notary Public, Greene County, Ohio.

(SEAL)

My commission expires May 21, 1917.

## Pennsylvania will have State-Wide Good Roads Day

May 25 has been officially designated as State-Wide Good Roads Day in Pennsylvania, an official proclamation having been issued by Governor Martin G. Brumbaugh of that State. The work will be under the direction of the various counties, with which the entire personnel of the State Highway Department will co-operate, as was the case last year, and every effort will be made to make the event even more successful than in 1915.

The official proclamation of Governor Brumbaugh follows:

"*Whereas,* There is an enlightened and generally universal interest in good roads for this commonwealth: and

"*Whereas,* The improvement and upkeep of our highways is now acknowledged to be an essential good to our people in transporting the products of the farm to the best markets, in affording increasingly convenient means of access on the part of our people in one part of the State to those in another, and in laying the foundation for a necessary preparedness: and

"*Whereas,* Many public-spirited citizens, great commercial bodies, civic associations, agricultural organizations, automobile clubs, and county organizations in the interest of good roads in Washington, Allegheny, Lawrence, Vanango, Clarion, Huntingdon, Mifflin, Blair, Chester, and other counties, have requested that a day be set aside to be known as 'State-Wide Good Roads Day': and

"*Whereas,* On Good Roads Day in 1915, over 78,000 citizens gave freely the day to work on the roads, above 11,000 teams were voluntarily put to use on the roads, while county organizations were formed in more than half the counties of the State to promote the movement for the right observance of Good Roads Day, and the judges in seventeen counties joined the Executive in issuing proclamations calling upon the citizens of their respective districts to participate in the hearty observance of this day, and many manufacturers with patriotic zeal made substantial contributions of cash and materials, declaring in many instances a holiday for their employees to permit their workmen to give the day to the highways:

*Therefore,* I, Martin G. Brumbaugh, Governor of this Commonwealth, fully in sympathy with the purpose of this and every movement that holds promise of better road conditions for our people, and deeply concerned to stimulate in every proper way a State-wide interest in good roads, and resolved, even with inadequate appropriations to make our State highways safe, comfortable, and permanent avenues of travel, do make this proclamation:

"That each and every supervisor of the townships of this commonwealth is obligated by law and in good conscience to give this movement cordial support and to make this day memorable in greatly improving the public roads;

"That all our citizens, having a patriotic regard for this great commonwealth shall so plan their personal duties as to give the entire day to the improvement of our highways or contribute to the proper local authorities such sum in money or such material as will add to the substantial good the day should accomplish;

"That all our citizens, living in cities or towns, and owning automobiles, go on this day to the country and volunteer their services in adding to the safety and comfort of themselves and others when traveling upon our highways; and

"That this day may be a State-wide, memorable action upon the part of our people in the performance of a great public service, to which the State Department of Highways will most cordially give its support and co-operative assistance, I hereby designate and set aside

THURSDAY, MAY 25, 1916, AS
STATE-WIDE GOOD ROADS DAY
IN PENNSYLVANIA.

By the Governor,
(*Signed*) MARTIN G. BRUMBAUGH."

There is every indication that the Good Roads Day this year will be even more successful than it was last year, as many counties which had no organizations are now forming them, and steps have been taken to secure united action. Governor Brumbaugh has placed himself at the disposal of the

# PROMPT DELIVERIES
## MIXERS
## PAVERS

**BOSS**

"HIGH SPEED" MIXERS ARE CARRIED IN STOCK FOR PROMPT DELIVERY IN THE CITIES NAMED BELOW BY BIG RESPONSIBLE JOBBERS WHO GIVE SERVICE AND STAND BACK OF OUR "IRON-CLAD," MONEY-BACK GUARANTEE.

**NEW YORK**
Edward Ehrbar
270 West St.

**CHICAGO**
R. H. Hyland Co.
323 Wells St.

**NEW ENGLAND STATES**
Dyar Supply Co.
66 Broadway, Cambridge, Mass.

**CALIFORNIA**
Good Roads Machinery Co.
510 Molino St.
Los Angeles

**OHIO**

**CLEVELAND**
McKenna Company
1851 E. 38th St.

**COLUMBUS**
Osborne & Sexton Machinery Co.

**INDIANA**
Bock Equipment Co.
602 Fletcher Trust Bld.
Indianapolis

**MINNESOTA**
H. E. Erickson & Co.
635 Plymouth Bldg.
Minneapolis, Minn.

**SOUTH**

**ATLANTA**
Good Roads Machinery Co.
38 Madison Ave.

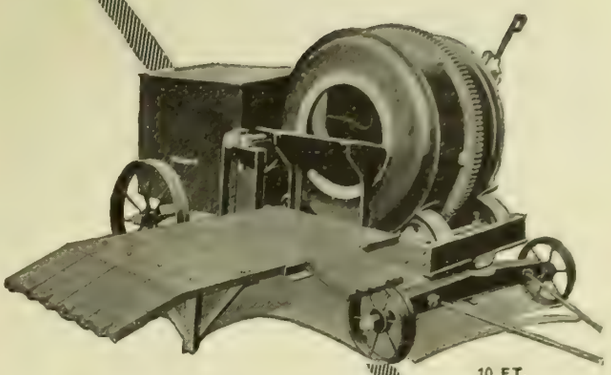
**NEW ORLEANS**
Ole K. Olson
823 Perdido St.

**PENNSYLVANIA**

**PITTSBURGH**
Standard Supply & Equipment Co.
1207 Liberty

**PHILADELPHIA**
L. F. Seyfert's Sons, Inc.
437 N. 34th St.

**NORTHWEST**
Hofius Steel & Equipment Co.
Spokane, Washington



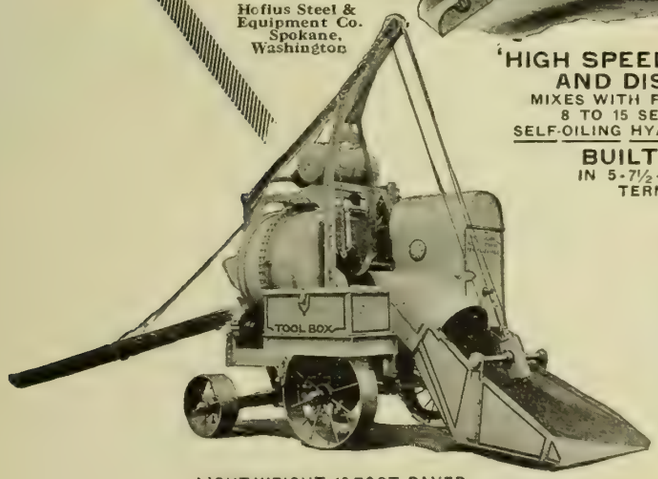
10 FT.
LOW CHARGER
**$300**
COMPLETE

5 FT.
SIZE
$185



## "HIGHSPEED"
Bridge Builders' and Alley Paving Mixer
TRACTION IF WANTED
3700 lbs. complete
INEXPENSIVE
ONE BAG
MIXER

"HIGH SPEED" MIXING AND DISCHARGE ACTION
MIXES WITH FEWER REVOLUTIONS
8 TO 15 SECOND DISCHARGE
SELF-OILING HYATT ROLLER BEARINGS
**BUILT OF STEEL**
IN 5-7½-10-15-FT. SIZES
TERMS TO SUIT




LIGHT-WEIGHT 10-FOOT PAVER
HIGH-SPEED STEEL TYPE
GAS, KEROSENE OR STEAM

WRITE OR WIRE
FOR ADDRESS OF NEAREST JOBBER

**AMERICAN CEMENT MACHINE CO., Inc.**
1185 JOHNSON STREET - KEOKUK, IOWA

State Highway Department, and will spend the day, just as he did last year, actually working and doing manual labor on the highways.

Last year, Venango County furnished an excellent example of what united and systematic effort can accomplish in a single day. The final estimate of the value of the work done on the roads of the county was $10,623. There were 2,092 men voluntarily working on the roads of the county last year, as well as 426 teams; 184 miles of roads were repaired and placed in first-class condition, 83 carloads of crushed slag having been used in this repair work.

Warren County was another which did excellent work last year, when 1,500 men and 300 teams were working all day on the roads, placing nearly every mile of highway in the county in excellent condition. In Warren, as in nearly every other county, the women and girls did their part by preparing and serving luncheon with hot coffee to the workers along all the roads on which the men were working. Good Roads Day in Pennsylvania is a successful annual event, and its success is due largely to the excellent co-operation of the men in every walk of life, and to the interest taken in it by the Governor and the State Highway Department.

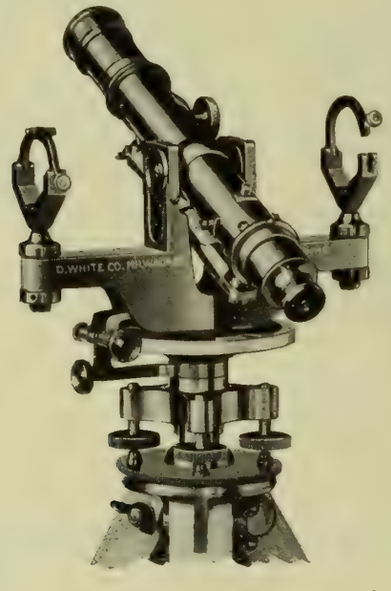
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## New "Convertible Level"

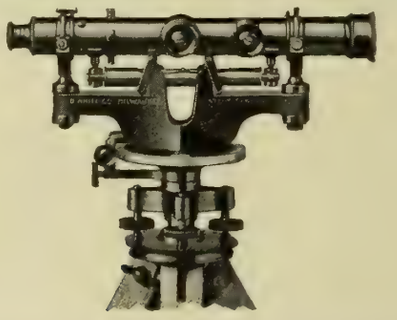
### Which is, in reality, a transit and level combined

The David White Co., Inc., 419 East Water Street, Milwaukee, Wis., has recently placed on the market an Improved Convertible Level or Modified Transit, which is shown by the accompanying illustrations.

Figure B shows the instrument when used as an ordinary level and Figure A when converted into a modified transit. The company points out that the predominant features on this new instrument are as follows:




The drop-center construction of the cross-bar with standards cast in one piece not only does away with the attaching and detaching of the separate standards each time it is desired to use same as a modified transit, but it permits also of level being converted into transit in ten seconds. The standards which are cast solid onto the cross-bar and remain there permanently prevent all possibility of same becoming lost or misplaced which has always been a serious objection to the old style convertible levels and, furthermore, the above arrangement does away with one adjustment; and the less adjustments there are on an instrument the less there are to get out of order.



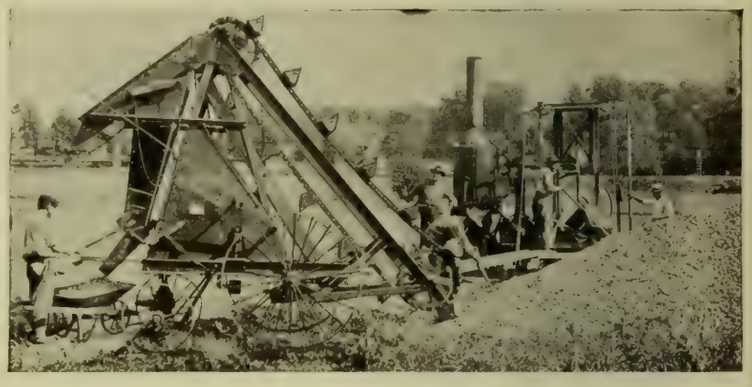
Circular containing detailed information, specifications, etc., will be mailed to all interested road builders, contractors, and engineers upon application to the company.

* * *

## Portable Wagon Loader and Stone and Gravel Handling Machinery

Book No. 213, descriptive of "Link-Belt Machinery for the Handling, Preparation, and Storing of Stone, Gravel, Sand, etc.," recently issued, contains 80 pages, profusely illustrated with photographs and drawings. Describes plants and equipment from the smallest contractor's portable wagon loader up to large equipment for stone quarries and gravel plants, which include conveyors, screens, grab buckets, locomotive cranes, excavators, carriers, etc.

Pages 64-68 are especially interesting to road builders. One illustration, reproduced herewith, shows a novel use of the



portable wagon loader on concrete road or foundation work. A special chute, placed low on the machine, is designed for filling wheelbarrows.

The saving in shovellers and wheelers is apparent. Wheelbarrows are loaded instantly and the shovellers are kept working continuously. It is estimated that, with an average concrete road gang, the loader will save seven men.

Book No. 213 will be sent free on request to the Link-Belt Company, Chicago, Ill.

* * *

The E. I. du Pont de Nemours & Company of Wilmington, Delaware, have just had printed a Clay Blasting Booklet. As it is the first booklet ever issued on this subject, it contains valuable and interesting information. Some of the phases covered are "Digging Clay," "Stripping," "Blasting Down Shale," "Digging Plastic Clays," "Mining Flint Clays," "Draining Clay Pits," as well as full information on the use of explosives.

The booklet will be sent to any address upon request.

* * *

## New Government Bulletin

### "Methods for the Determination of the Physical Properties of Road-Building Rock."

This is the title to Bulletin No. 347 of the United States Department of Agriculture, by Frank H. Jackson, Jr., assistant testing engineer. Being a partial revision of a former bulletin issued June 10, 1912, the subject matter has been revised and brought up to date, and limited to a description of the methods used by the United States Office of Public Roads and Rural Engineering for testing rock for road building. It is intended to serve as a laboratory manual for those who have occasion to make such tests.

The various tests described are intended to determine the hardness, toughness, and binding power of various rocks. Hardness indicates resistance of the rock to the abrasion of traffic; toughness, the resistance to fracture under traffic; and binding power or cementing value, the ability of the rock dust, in contact with water, to cement the stones of a macadam road together.

The various tests described are as follows:

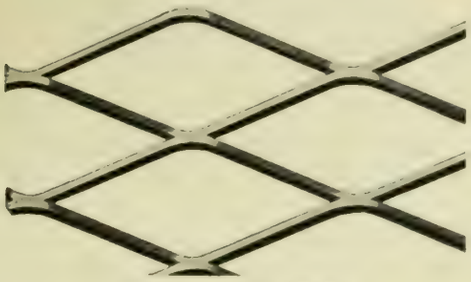
# *Successfully Used in Over 500 Permanent Concrete Roads*

## Kahn Road Mesh

Kahn Road Mesh is a strong, rigid reinforcing, manufactured from one piece metal plates. It is shipped in large flat sheets, that, when once placed cannot be jarred from position.

It eliminates the unrolling of coils, cutting to length and tying into position.

Kahn Mesh will fulfill all specifications and help materially to make your concrete road a better one.

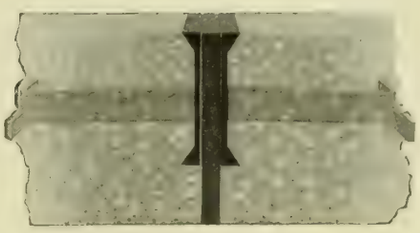


KAHN ROAD MESH

## Kahn Armor Plates

Kahn Beveled Edge Armor Plates eliminate the possibility of the pavement chipping or cracking at the expansion joint.

The beveled edge (an exclusive feature) does away with the square corner of the concrete next to the plate and this with the split-end prongs provides a solid anchorage that no jarring nor traffic can loosen.



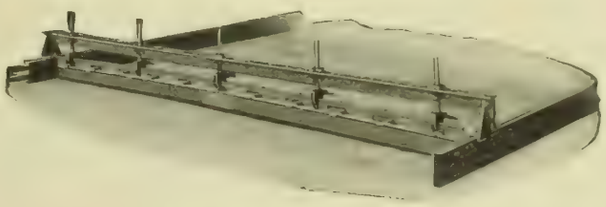
KAHN ARMOR PLATE

## Kahn Installing Device

Kahn Improved Installing Device insures the correct placing of the Armor Plates in every installation. Simple in operation and saves greatly in time and labor.

It can be adjusted to any crown and when once set can be used for all plates on the job without further adjustment.

With Kahn Installing Device, the space between the bars and the armor plate permits the finishing of the concrete surface flush with the top of the armor plate. A very important feature.



KAHN INSTALLING DEVICE

## Kahn Curb Bars

Kahn Curb Bars provide a positive protection against the chipping or cracking of the curb along the edges. The concrete curb is protected with a steel edge which positively resists wear and abrasion.

The Kahn Curb Bar is made from one solid piece of steel. It has deep anchorage that in itself provides a reinforcement to the curb proper as well as a steel protection to the edge.



KAHN CURB BAR

KAHN Building Products — TRUSSED CONCRETE STEEL CO

*Send for Illustrated Folder, Information and Prices.*

*Trussed Concrete Steel Company*

Department A-57 YOUNGSTOWN, OHIO

REPRESENTATIVES IN PRINCIPAL CITIES

KAHN Building Products — TRUSSED CONCRETE STEEL CO

TELL 'EM YOU SAW IT HERE.

# $2,600 Du Pont - Davis Road Photograph Prize Contest $2,600

## One Hundred and Sixty-Six Cash Prizes for Road Photographs

**Offered by General Coleman du Pont, of Wilmington, Delaware, and Charles Henry Davis, C. E., of South Yarmouth, Cape Cod, Massachusetts.**

**To secure for the NATIONAL HIGHWAYS ASSOCIATION Photographs of Roads, and in the hope of adding strength to its membership and means, so that the Association may prosecute its work for**

***"GOOD ROADS EVERYWHERE"***

***Photographs Will Be Judged By Theodore Roosevelt, Mark Sullivan and Ida M. Tarbell***

**1 FIRST PRIZE OF $500.00**
**5 SECOND PRIZES OF $100.00 EACH**
**20 THIRD PRIZES OF $ 25.00 EACH**
**40 FOURTH PRIZES OF $15.00 EACH**
**100 FIFTH PRIZES OF $ 5.00 EACH**
**166 PRIZES TOTALING $2,600.00**

Photographs will be judged first upon their merit in showing road conditions (good or bad); second, pictorial interest; third, photographic excellence.

Any one may become a competitor. It is not required that competitors be members of the Association, and no preference will be given members over non-members in awarding the prizes.

It is hoped by the Association that many will be sufficiently interested in its patriotic work to become members, and thus help the cause of "GOOD ROADS EVERYWHERE." This can be done by sending to the Association the dues of any class of membership, in cash (by registered mail), by money order or check to the order of the Association. Classes of membership are as follows:—

**Highway Members, $5.00 per annum; Scout Members, 50c. per annum; Camp Fire Members, 50c. per annum.**

Any boy under eighteen can become a Scout Member; any girl under eighteen a Camp Fire Member. All men and women eighteen and over are eligible to membership except in Scout and Camp Fire Classes.

If you want further information regarding the National Highways Association, send nine cents in stamps to its "Work Shop" at South Yarmouth, Mass., and receive a beautiful three-color map, and a large sheet, also in three colors, giving all particulars about the Association. The nine cents is exact cost of map, information sheet, envelope and postage.

**CONDITIONS OF CONTEST**

1. A contestant may submit any number of photographs, any one or all of which may receive a prize.
2. All photographs must be of some road within the United States.
3. Photographs receiving a prize shall thereby become the property of the National Highways Association with full legal title and copyright vested therein.
4. The full name (do not use initials) and full address of the contestants must be upon the back of each and every photograph submitted.
5. No photographs can be returned. But none will be published by the Association or allowed by them to be published by others, save such as win prizes and are purchased by agreement after the contest is over.
6. Photographs should be addressed to "GOOD ROADS EVERYWHERE" Photograph Contest, National Highways Association, Washington, D. C.
7. Contest closes at noon, Tuesday, November 7, 1916. Prizes will be awarded as soon thereafter as physically possible.

There are no other conditions. There is no limitation as to the kind of photograph; size; when taken; by whom; details shown; or number submitted by any contestant (man, woman or child.) No letters should or need be written by any contestant, and no correspondence will be entered into about the competition.

ROADS WILL BE PAID FOR BY THE PEOPLE. THEY ARE USED BY ALL THE PEOPLE AND ARE FREE TO ALL THE PEOPLE.

**COLEMAN DU PONT**
**CHARLES H. DAVIS**


1. Specific gravity; weight per cu. ft.; water absorption.
2. Deval abrasion test.
3. Hardness test with Dorry machine.
4. Toughness test with Page impact machine.
5. Cementing value test.
6. Compression test.

The bulletin is illustrated with detailed drawings of all the machines used.

Appendix "B" of the bulletin gives a complete list of all apparatus necessary to carry on the work of rock testing. The list is reproduced herewith:

EQUIPMENT OF A ROAD-MATERIAL TESTING LABORATORY

1 Deval abrasion machine having four cylinders.
1 impact machine for toughness test.
1 Dorry machine for hardness test.
1 impact machine for cementing-value test.
1 cementing-value briquette-forming machine.
2 ball mills.
1 diamond core drill, with suitable drill press.
1 diamond saw.
1 grinding lap.
5 pounds No. 120 carborundum.
1 small jaw crusher.
1 scale, capacity 5 kilograms and sensitive to 0.5 gram.
1 scale, capacity 100 grams and sensitive to 0.1 gram.
1 balance, capacity 100 grams and sensitive to 0.01 gram.
1 large drying oven.
1 small drying oven, with temperature regulating device.
1 ten-inch desiccator, with calcium chloride.
1 millimeter scale.
1 dozen pint jars with metal screw caps.
1 dozen 3-quart enameled iron pans.
1 100 c.c. graduate.
1 100 c.c. beaker.
1 15-inch standard sieve, with 30 meshes per linear inch.
1 15-inch standard sieve, with 40 meshes per linear inch.
1 16-inch sieve, reinforced with square openings 1-16 inch in size.
100 burlap bags about 17 inches square.
500 blank tags.
1 50-pound anvil.
1 ten-pound sledge.
1 three-pound double face stone hammer.
1 1½-pound single face stone hammer.
1 six-inch scoop.
1 barrel quartz sand between No. 30 and No. 40 sieves.
1 fifty-pound bale of waste.
1 waste can.
1 oil can and motor oil.

"This equipment should be sufficient to enable a force of three men to maintain an average of twenty-four routing rock analyses per week. The complete cost of equipping a laboratory as outlined above should not exceed $1,500 and would probably not reach this figure if some of the larger machines were shaft driven instead of direct connected."

* * *

## A "Dope Book" You Should Have

Fifteen pages of concise cost data, tables of weights and quantities, and helpful suggestions for the contractor, are contained in "The Concrete Dope Book" recently issued by the Cement Tile Machinery Company, 555 Rath Street, Waterloo, Iowa. Following is a list of a few of the valuable tables and other data given in the book:

1. Cost of 1,000 square feet of sidewalk of differing thicknesses and mix, compiled by a Waterloo, Iowa, contractor.
2. Fuller's rule for quantities.
3. Materials for one cubic yard of concrete.
4. Cost of various classes of concrete construction.
5. Amount of material for arch culverts.
6. Miscellaneous weights.
7. "Little Helps in Estimating."
8. "Concrete Pavement Calculations." Etc.

It is such data as these that the estimator is likely to need in a hurry some day, and it would be well to send for the book and have it on hand for reference when the next estimate comes up.



*New Style*

**Scarifying Attachments**

*for*

# Kelly-Springfield Road Rollers

Hundreds of These Scarifiers Now Being Used By

**Contractors, Counties, Cities, Townships, Etc.**

*Saves Time and Money*

CUTS FULL WIDTH OF ROLLER THROUGH HARD MACADAM

WE BUILD

*STEAM ROLLERS—All Sizes*
*TANDEM STEAM ROLLERS*
*BRICK PAVEMENT ROLLERS*

WE BUILD

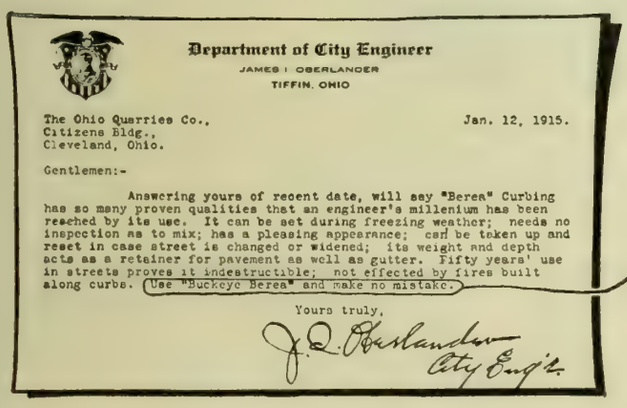
*GASOLINE ROLLERS—All Sizes*
*TANDEM GASOLINE ROLLERS*
*ASPHALT ROLLERS*

*WRITE FOR CATALOGUE*

## KELLY-SPRINGFIELD ROAD ROLLER CO.

SPRINGFIELD, OHIO





Department of City Engineer
JAMES I. OBERLANDER
TIFFIN, OHIO

The Ohio Quarries Co.,
Citizens Bldg.,
Cleveland, Ohio.

Jan. 12, 1915.

Gentlemen:-

Answering yours of recent date, will say "Berea" Curbing has so many proven qualities that an engineer's millenium has been reached by its use. It can be set during freezing weather; needs no inspection as to mix; has a pleasing appearance; can be taken up and reset in case street is changed or widened; its weight and depth acts as a retainer for pavement as well as gutter. Fifty years' use in streets proves it indestructible; not effected by fires built along curbs. Use "Buckeye Berea" and make no mistake.

Yours truly,

J. L. Oberlander
City Eng'r.

*Specify Buckeye Berea*

**That's the only way to "make sure" you're getting "Buckeye Berea" Natural Sandstone Curbing!**

*Man cannot mix a curbing that equals "Buckeye Berea" natural sandstone—the best that Nature made!*

Why guess on "Construction Ifs"—why theorize on "Wear Results" when you dont have to?

Why not lay *a curbing that will last longer than the pavement it serves?* That can be turned over and relaid at slight expense when the next pavement goes down!

By insisting on *"Buckeye Berea" as produced by the Ohio Quarries Co.*, you will be assured of lasting endurance! You'll know beforehand that you're obtaining *selected* and *"known"* quality!

*THE OHIO QUARRIES CO.*
*CLEVELAND, OHIO.*

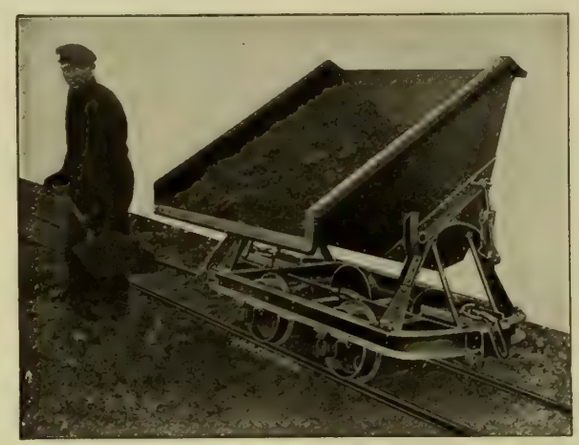
KOPPEL

# Road Builders' Equipment

**Often Pays for Itself on a Single Job**

## For Sale OR Rent

**Koppel Cars, Dinkies, Portable Track, Switches, Turnouts, Etc.**



**"IDEAL" Standard Two-Way Heavy Duty Dump Car**

Latest type of reinforced road car designed for extra heavy service. Spring Draft Gear, Spring Roller Bearings. Self cleaning and dumps material 6 inches clear of track. Can be loaded easily by hand when necessary. Dead load low, compared with capacity. Rated capacity 1¼ cu. yds., 24 inch gauge; other sizes in stock. Patent applied for.

**Every Highway Official and Contractor Needs Our Roadbuilders' Handbook on Good Roads Construction. Sent free on request.**

*We have outfits in first-class condition assembled ready to ship on short notice. Let us know the details of your hauling problem and we will make you sale or rental propositions.*

Our engineers are specialists in hauling equipment. Their services are at your disposal at any time in planning the most economical method of handling any job. Write them.

OAK

ORENSTEIN-ARTHUR KOPPEL CO.

**PLANT: KOPPEL, PA.**

**SALES OFFICES:** New York, Chicago, Pittsburgh, San Francisco



Atlantic H. O. Asphalt applied to Lansdowne, Pa., Streets

# Atlantic H.O. Asphalt

**(Applied Hot)**

## Reduces Road-Maintenance Cost

This is the tried-and-true paving material that seals and waterproofs roads perfectly, producing a hard, tough surface that resists the incessant, abrasive onslaughts of traffic. Atlantic H. O. Asphalt is not a theoretical road-material—it is now and *has* been giving perfect service on mile after mile of urban and rural roads, under hardest conditions.

Atlantic H. O. Asphalt is Mexican asphalt, pure, tough and rubbery. It is heavy, waterproof and durable to a surprising degree. It gives best results when covered with finely crushed stone-chips or gravel. Applied by the Atlantic Refining Company's modern equipment operated by experienced men, under the exacting supervision of roadway experts. We will gladly furnish specific information as to quantities required, methods of application, etc.

**The Atlantic Refining Company**
**Philadelphia Pittsburgh**

Quality in




Expansion Joints

100 – 50 = 50

Figures based upon laboratory tests cannot deceive.

A joint compound containing 50% foreign matter is only 50% efficient.

Some expansion joint products are made to simply fill up space and get by.

Other products are made to serve correctly the purpose for which they are intended and by so doing give satisfaction and make good customers on each sale

Which do you want on your work, Mr. Engineer?

On the rigidity of your specifications depends the quality of the materials to be used on your paving work.

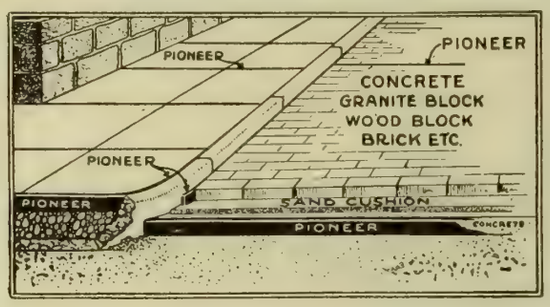
We recommend and feature our "PIONEER" No. 1 Expansion Joint Compound, which is a pure asphalt reinforced joint, but we manufacture a cheaper joint, "PIONEER" No. 3, which meets open specifications.

Samples, literature, and prices, cheerfully submitted upon request.

THE PIONEER ASPHALT COMPANY

*Producers of Highest Quality Bituminous Products*

LAWRENCEVILLE, ILLINOIS






FOR SALE! FOR SALE!

10-TON KELLY-SPRINGFIELD ROLLER
12-TON KELLY-SPRINGFIELD ROLLER
25 H. P. TWIN CYLINDER ROAD ENGINE
30 INCH GAUGE, 10-TON PORTER LOCOMOTIVE
36 INCH GAUGE, 11-TON AM. LOCOMOTIVE
15-FT. STANDARD CONCRETE MIXER
2 PORTABLE ROCK CRUSHERS
2 STATIONARY ROCK CRUSHERS
4 HOISTING ENGINES
8 2-YARD SIDE DUMP CARS
1 GALION "ENGINE" ROAD GRADER

E. E. McCARTNEY - CANFIELD, OHIO


## Ohio

(*Continued from page* 35)

"There was a very complete opinion by Judge Jones in the Court below, and we are in harmony with the views expressed by him."

This decision clears the way for an emergency levy outside all the limitations of the Smith one per cent. tax law, in all counties where conditions warrant its use as such, and the commissioners of such county are satisfied that the ordinary levies authorized by law for road improvement purposes will be inadequate to provide money to repair or improve such road or roads as are necessary from the causes enumerated in Section 7419 G. C.

The case may not be carried to the Supreme Court, and if not, then the decision of the Court of Appeals will be accepted as settling the controversy over the proper construction of the sections of the General Code in question. We caution the officials of the several counties not to abuse this right of levy, but rather protect it, by using the other levying sections of law for road improvement which are now limited ONLY by the maximum rate of FIFTEEN MILLS. ONLY in case of actual emergency, or where the public investment is declining in value and service for reason of the inability of county officials to protect it, should this section of law be utilized.

A postcard addressed to the Blaw Steel Construction Company, of Pittsburgh, Pa., will bring you their latest literature on Concrete Road, Sidewalk, Curb, and Curb and Gutter forms.

* * *

Everything for use in, on, or under highways, is the way the Beach Manufacturing Company, Charlotte, Mich., express it in their new booklet, "Everything for Roads." The booklet contains the description and illustrations of their many products and is a splendid addition to the files of highway officials, contractors, etc. Just now they are presenting their "Tamper Roller" which is advertised in another page of this magazine. The booklet will be mailed interested parties on request.

* * *

H. L. Dougherty has been appointed superintendent of highways in Washington County, Penn. Mr. Dougherty has been with the State Highway Department for four years, having started in in 1912 as rodman, and has worked his way up to his present position. He has been attached to the office in District Number 10, with headquarters at Wellsboro, Tioga County. He is a graduate of Pennsylvania State College, 1911, prior to which time he attended Susquehanna University.

* * *

On April 11, the State Highway Department of Pennsylvania awarded the contract for ninety steel drags to the Good Roads Machinery Company, Kennett Square, the lowest bidder at the opening of bids on April 5. The average price paid for these drags was $12.25.

The bids for wooden drags and tool boxes were rejected because the prices offered were deemed excessive.

* * *

James M. Dilley has been appointed city engineer of Cambridge, Ohio, succeeding Karl Gosgrove, who has resigned to enter the race for the nomination for county surveyor of Guernsey County. Mr. Dilley was for several years in the office of the city engineer, and later was connected with the United States Geological Survey for two years.

* * *

## Road Surfacing

Road surfacing, as distinguished from applications of oil for dust-laying, is covered in principle and practice in a booklet, Trinidad Liquid Asphalt, just issued by the Barber Asphalt Paving Company (Philadelphia). The essentials of successful "carpet coating" with asphaltic materials are fully explained. As illustrations, the pamphlet contains photos of park drives, city boulevards, suburban streets and country roads resurfaced with liquid asphalt by both hot and cold applications. Full specifications, in the form of explicit directions for the laying of carpet coats, are included.

* * *

People of Blair, Kan., and along the highway east from Blair to Wathena, have begun a movement for electric lights for the town. This may ultimately result in a white way through the Peter's Creek valley all the way from St. Joseph, Mo., to Troy, Kan., a distance of fourteen miles.

* * *

Registration was above 100 at the Northwestern Michigan Road Institute held on March 22 and 23 at Saginaw, Mich. With few exceptions they were county and township road commissioners. State Highway Commissioner Rogers was present and gave an address in which he discussed the laws relating to the construction and repair of State reward roads.

* * *

## Hutchinson, Kan., to Build Monolithic Brick

City Engineer G. L. McLane, of Hutchinson, Kan., has prepared plans and specifications for paving Fourth Avenue, east, with monolithic brick. City Engineer Titus, of Arkansas City, is also contemplating the adoption of this type of paving. South from Great Bend, Kan., there is a road traversing a sandy river bottom where the same construction is under consideration. Altogether, this new method of construction is obtaining serious consideration in Kansas.

* * *

Fielding & Shepley, Inc., St. Paul, Minn., will lay the remaining block of concrete pavement called for on Warsaw Street, St. Paul, this spring. Cold weather stopped the work




# You Can Make Bigger Profits

CONTRACTORS who do their hauling with this Sterling Automatic Dump Truck can make bigger profits, because it costs them less to do the work. It is a profitable investment, not only because it cuts handling and hauling costs, but also because of its low maintenance cost. It is as nearly fool-proof and trouble-proof as any mechanism can be.

Sterling Automatic Dump Trucks are especially adapted for speedy and economical hauling and handling in connection with road and street construction and maintenance work. They are built to withstand hard usage, day in and day out, week in and week out.

The Sterling unit power plant is instantly accessible. The transmission is under the floor boards—not under the seat or gasoline tank and not under the body. Sterling tubular propeller shafts are stronger and lighter than a solid shaft, reducing lost motion due to wear, lessening the necessity for lubrication and attention, decreasing the total weight of truck, minimizing the cost of replacement.

These are only a few of the reasons why contractors today are finding Sterling trucks the most profitable investment. We have some interesting figures covering the cost of handling with automatic dump trucks. Write for them.

Sterling TRUCKS

## Sterling Motor Truck Company

831 Rogers Street, Milwaukee, Wis.

BUILDERS OF MOTOR TRUCKS EXCLUSIVELY FOR NINE YEARS

## Plymouth Gasoline Locomotives Solve Haulage Costs on Long Beach Job

Many millions are being spent at Long Beach, Long Island, near New York City, to make a summer colony to rival Newport.

Turf from the marshes has to be hauled to the sandhills and often the tracks are bogged down, tidewater is up to engine base, and some of the grades are 15%.

And so the U. S. Drainage and Irrigation Co., which has the contract, had to have dependable power.



*From a Photo*

### "They Run Up to Their Hubs in Water," Says Superintendent Kehoe

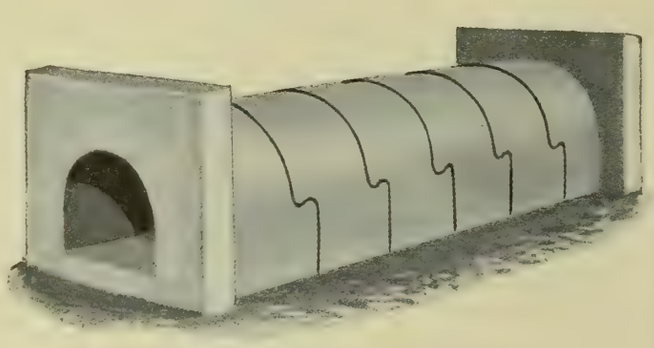
In discussing the work of the two "Plymouth" Locomotives, Supt Kehoe said: "I've run gasoline engines fifteen years, but I never saw anything like the 'Plymouths' for work or for low cost of operation. They run up to their hubs in water from daylight to dark and never give us any trouble. Each locomotive makes the 1⅛ mile trip in six minutes.

**An Easily Read Pamphlet—Yours for the Asking** Kehoe's full experience with the "Plymouth" and many others, showing actual cost data, will be sent any one upon request. It is worth any one's reading.

**THE J. D. FATE COMPANY**
213 Riggs Avenue PLYMOUTH, OHIO

## THE CULVERT WITHOUT APOLOGIES

***Hall Interlocking Concrete Culvert***



THE CULVERT EVERLASTING

***Manufactured Under Exclusive Contract***

**SCHULZ & HODGSON**
19 S. LaSALLE ST. CHICAGO, ILLINOIS

TELL 'EM YOU SAW IT HERE.


last fall. Specifications call for a 1:2:3 mixture with local sand and crushed trap rock. W. N. Goss is commissioner of public works. Oscar Clausen is city engineer and J. E. Carroll is assistant city engineer.

* * *

Tentative plans for the paving of twenty-four streets and alleys are being made in Muscatine, Iowa, the biggest paving program ever contemplated. C. H. Young is city engineer.

* * *

## The Two Biggest Concrete Mixers in the World

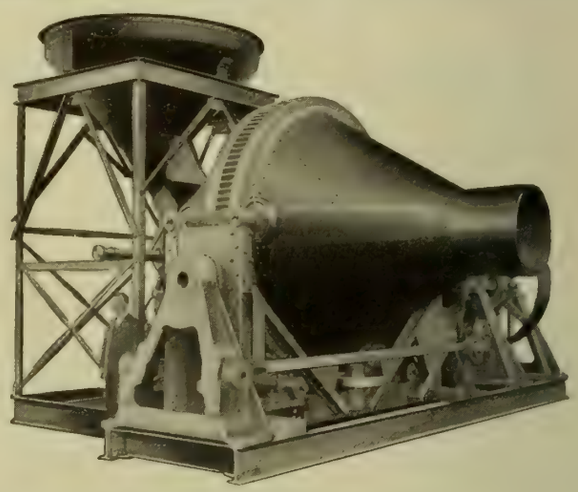
The T. L. Smith Company, of Milwaukee, has just completed the two largest concrete mixers ever constructed. They are of the tilting type, each with a capacity of 108 cubic feet of mixed concrete per batch, or between 150 and 160 cubic feet of loose material.

But figures may not give as adequate an idea of these monsters as a few comparisons.

A paving mixer would be termed "large" if it held eighteen cubic feet of mixed materials. One of these machines has six times the capacity of such a paver. Many nine-foot pavers are used nowadays. Twelve such machines have a capacity of four cubic yards—just equal to one of these mammoths.

The largest mixer used on the Panama Canal was less than half the size of one of these machines.

The photograph shows the over-all height to the top of the hopper to the top of the hopper to be three times that of an ordinary sized man. He looks lost, standing alongside the immense framework.



The purpose of these machines is as follows:

The Hardaway Contracting Co., of Washington, D. C., recently took a contract for an immense concrete dam to be built at Salisbury, N. C. The contract required them to pour 60,000 cubic yards per month until the job was finished, or a total of about 1,000,000 cubic yards. On looking over the ground, they found that four two-yard mixers would take up too much lateral space. It became absolutely necessary, therefore, for them to use two four-yard mixers.

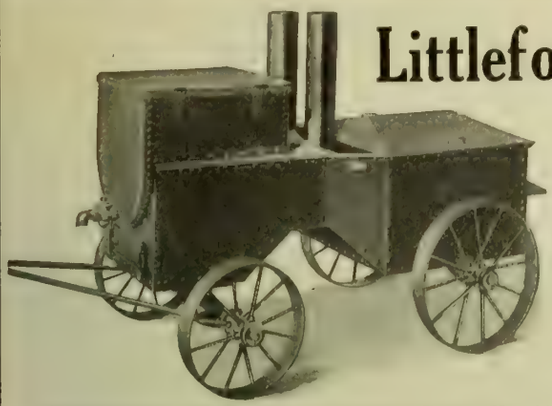
Each machine is mounted on steel skids with an enormous bath hopper supported by a steel frame. The mixer itself is equipped with a power tilt and further equipped with Allis Chalmers clutch pulley. The weight of each machine is 46,000 pounds. The mixer drum is made of 3-8 inch steel. The inside diameter of the drum ring is nine feet, six inches.

* * *

## We're in Good Company, Anyway

"One of the most encouraging things which we have encountered in our work is the sympathic and intelligent co-operation which we are receiving from such current periodicals as the Engineering Record Better Roads and Streets, and many other publications"—item from the latest number of The Monad, the official publication of the American Association of Engineers, 29 South LaSalle St., Chicago.

And this reminds us to say that your ten dollars will be amply repaid in the enjoyment you will get in reading over the breezy items in this live little monthly organ; to say nothing, of course, of all the other benefits, direct and indirect, to be derived.



Combination Tar Heater and Pebble Dryer No. 11

# Littleford Portable TAR and ASPHALT HEATERS

STAND THE RACKET



Tar and Asphalt Heater No. 48

## Favored by Leading Municipalities, Street and Road Contractors, etc.

Because it's recognized as the most durable; "as near wear-and-time-proof as anything can be made." Body of heavy ¼-inch thick steel plate riveted at corners to connecting angles. Heavy liner furnace plates positively protect outside shell of firebox by allowing circulation of air between it and the furnace proper. Wheels made with heavy cast hub with chilled core and broad steel tires. Spokes of wrought steel staggered give additional strength. Special construction of fifth wheel makes wagon especially well adapted for traveling over rough roads and streets.

*"Littleford's Little Leaders—Completely Illustrated, Sent on Request. Every One Eternally Good and an Unmatchable Value.*



Heater No. 69

LITTLEFORD Tank Wagons, Portable Tar Heaters, Gravel Driers, Combined Gravel Drier and Tar Heaters ARE LABOR SAVERS AND PROFIT MAKERS FOR STREET AND ROAD CONTRACTORS

**LITTLEFORD BROTHERS** 400 East Pearl Street CINCINNATI, OHIO

*THE SOLUTION OF THE SIGN PROBLEM*

# THE INTERCHANGEABLE CROSSROADS DIRECTION SIGN

**Gives any reading desired, for permanent or temporary signs: COLUMBUS 12 M., DANGER, SLOW DOWN, BRIDGE OUT, ROAD CLOSED, DETOUR—1 m. S. I m. W., USE THE WHOLE ROAD, Etc.**
**Just the thing for ROAD NAME SIGNS and BRIDGE NUMBERS.**




Interchangeable Sign (Assembled)

A
Plain
Permanent
Indestructible
Weatherproof
All-Metal
Sign




Sign (Disassembled Showing Separate Letters and Back Plate)

Notice Top and Bottom Extensions Insuring Perfect Alignment and Proper Spacing Between Letters.

Order crossroads direction signs as you would anything else. Just say how many. Ten, fifty or a thousand at a day's notice. Keep a few on hand and put them up as you need them; it takes sixty seconds to permanently assemble a twelve letter sign.

THE INTERCHANGEABLE CROSSROADS DIRECTION SIGN conforms to the specifications of the State Highway Department.

**The Ohio Culvert Pipe Co.,** Tiffin, Ohio, U. S. A.

Under fills varying from 15 inches to 30 feet

"ACME" (NESTABLE)

Corrugated Anti-Corrosive NO-CO-RO METAL Galvanized Culverts

are serving splendidly




This shows a 48 inch "ACME" (Nestable) Corrugated Anti-Corrosive NO-CO-RO METAL Culvert 120 feet long under a 37-foot fill.

And some of these have been giving such service for eight (8) years with no sign of deterioration yet in sight.

But remember: The fact that "ACME" (Nestable) Corrugated Anti-Corrosive NO-CO-RO METAL Culverts are giving this service, does not indicate that all corrugated culverts will do as well. It's the "ACME" YOU want.

Shipped, Set-up or knocked-down and nested, as you prefer.

Put us on your inquiry list, or, better, send for our Catalog G-2 today.

THE CANTON CULVERT & SILO CO.
MANUFACTURERS
CANTON, OHIO, U.S.A.



The Sunbury Automatic Car Unloader

Highest Efficiency Lowest Operating Cost

Absolutely Automatic on Sand, Screenings, Slag, Stone, Small Coal, or Other Loose Material.

WRITE FOR CATALOGUE.

THE SUNBURY MANUFACTURING CO.
SUNBURY, OHIO

C. G. Milburn, Distributor, 600 Columbus Savings & Trust Bldg., Columbus, Ohio


## The Smith Mixerette

A new folder, illustrating all the possible combinations of the Smith Mixerette, has just been issued by the T. L. Smith Co., 3119-X Hadley St., Milwaukee, Wis.

The Mixerette is the smallest of the Smith line, having a capacity of three cubic feet (N. A. M. M. wet batch rating) per batch, or approximately five cubic feet per hour. The



illustration shows one of the machines being used by the Columbus (Ohio) Railway, Power & Light Co., for laying the concrete foundation in double-track work. For this use it was equipped with a power charger.

Other pictures and diagrams shown on the folder illustrate the Mixerette equipped with a gated batch hopper and a sixteen-inch low charging platform, also with hoist mounted on truck between engine and mixer drum.

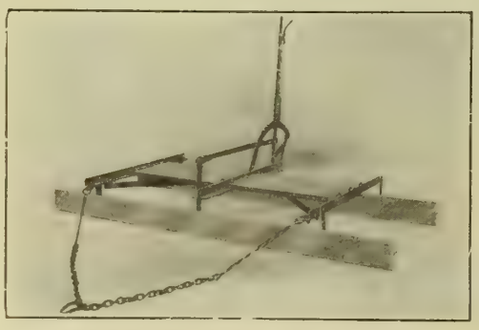
Contractors should write for this new folder.

* * *

## The New "Barrett" Expansion Joint

A new expansion joint for use in concrete and brick pavements has just been placed on the market by the Barrett Company, New York City, Philadelphia, Cleveland, and Chicago. This joint, or rather joint filler, recently examined by the writer, gives every promise of becoming extremely popular.

The Barrett Expansion Joint, as it will be commercially known, is manufactured by the new fiber-weld process which insures the production of a bituminous mastic of an unusually fine texture, which in turn insures a high tensile strength so that the joint will retain its proper shape at all temperatures to which paving is subjected. The manufacturers claim that the joint is absolutely waterproof, and that it cannot be injured in any way by automobile oils or street acids. It is flexible and pliable under all weather conditions, so that it will not become brittle with age, and it will not soften or run in warm weather, or crack and chip in cold weather.

The AMERICAN Champion Adjustable Road Drag.

THE AMERICAN CHAMPION ADJUSTABLE ROAD DRAG

It cuts and crushes, levels and smooths the road, all in one operation.

Cuts the cost of dragging right in two.

Made of steel, with hard wood or corrugated iron top, as desired.

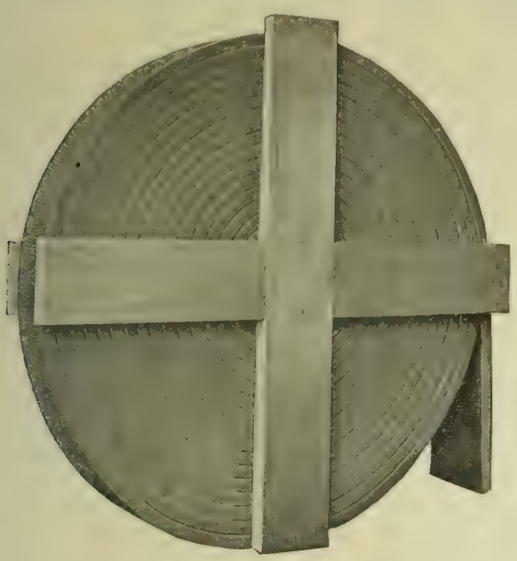
Don't use a crude and out-of-date Road Drag when you can get an AMERICAN Champion for littl money.

*You will be interested in our Road Drag Bulletin. It is free.*

THE GOOD ROADS MACHINERY CO. - Kennett Square, Pa.

Another claim made by the manufacturers is that this joint furnishes all the elasticity of the poured bituminous joint and that it has no hard and unyielding layers of reinforcement of one kind or another. It is a uniform and homogeneous mastic which will not split and separate or slip under pressure of expansion, and will not rot or deteriorate in service, a most important feature in view of the fact that when expansion joints are installed, they are usually along the curb where they are subject to the greatest amount of moisture and street liquids.

This joint offers great protection to the edges of the concrete or brick block pavement. It is simple to install, and



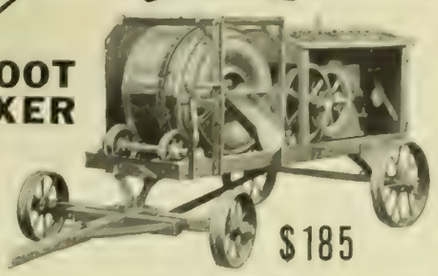
comes in a form that will meet with the instant and hearty approval of contractors and others who use it. This is one of the real features of the new Barrett joint—it unrolls like a ribbon, as it is shipped in reels of fifty and one hundred lineal feet, eliminating many joints in placing it longitudinally, and making it possible to carry the joint clear across any width of pavement as a transverse joint.

In installing it, a width is selected which will stand in place about one-half inch above the finished surface of the pavement, and the joint is then flattened out under traffic so that it mushrooms and covers the edges of the concrete or brick on both sides of the joint. The mastic is so tough and still so resilient that it will withstand the wear of traffic, thereby affording protection to the otherwise exposed edges of the pavement.

As has already been stated, the new Barrett joint comes in rolls in all practical widths and thicknesses, and is ready to lay. It is simply unrolled, cut to the desired length, and put in place without requiring any tools, equipment, skilled labor, heating or pouring apparatus. There is, therefore, no waste, and the amount of material required for any contract can readily and accurately be estimated.

PRICE + QUALITY

5-FOOT MIXER



$185

Send For This Book

Learn about the BIGGEST CONCRETE MIXER VALUE OF 1916. Why pay more when you can get a 5-foot "Northwestern" for $185—and on EASY PAYMENTS?

This mixer is built from drum to team pole in our own factory—and built RIGHT. It is a well-tried, reliable machine embodying all the best features of mixer construction and **we guarantee it to give satisfaction.** It has 4 H. P. topped cooled engine, standard wheelbarrow hopper, steel housing and team pole with truck of standard wagon gauge. Weight 2,400 lbs. Also made in larger sizes. Ask for Book No. 11



Northwestern Steel & Iron Works
Eau Claire, Wisconsin
Capital Stock, $[illegible]
Also a complete line of Concrete Tile Forms

"NORTHWESTERN"

WANTED

Second-Hand 24" Gauge Locomotive from 5 to 6 tons service weight. Koppel engines preferred. Also dump cars and portable track, 24" gauge. Also want to purchase Second-Hand Locomotives, 9x14 and 10x16, provided they are in good working condition.

Address

A. J. BRADY, Canton, Ohio

SAFETY FIRST

KYROCK

KENTUCKY NATURAL ROCK ASPHALT

THE COMING ROADWAY

The only Asphalt Surface furnishing a Safety tread for Horses and Autos. Why?

*Send for Booklet*

THE WADSWORTH STONE & PAVING CO. - - Pittsburgh, Pa.

"HARRIS PAVERS"
Daily Capacity 40,000
THE HARRIS BRICK COMPANY
Main Office CINCINNATI, OHIO
Factory ZANESVILLE, OHIO

"Hydrolene"
Asphalt Products for Road Building are Unsurpassed
Road Binders, Asphaltic Cements, Road Oil
SUN COMPANY
Toledo, Ohio Philadelphia, Pa. Chicago, Ill.

PENNSYLVANIA PORTLAND CEMENT
"For Better Roads and Streets"
PENNSYLVANIA CEMENT COMPANY
30 East 42d Street NEW YORK

CHICAGO PAVING LABORATORY
LESTER KIRSCHBRAUN, Ch. E., Director
Consulting and Testing Engineers
Pavements and Paving Materials
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Reports, Specifications, Plant, Street and Laboratory Inspection
Asphalts
Tars
Creosote Oils
Road Oils
Binders
Petroleum

In addition to the foregoing uses for this joint, it is also used in the construction of concrete sidewalks, and in all classes of construction where expansion joints are required.

The Barrett Expansion Joint comes in widths of three and one-half, four, five, six, seven, and eight inches, and in the following thicknesses: one-eighth, one-quarter, three-eighths, one-half, three-quarters, and one inch, or thicker if desired. Where the thickness is less than one-half inch, the rolls contain one hundred lineal feet, and where the thickness is one-half inch or over, they contain fifty lineal feet.

* * *

The April issue of *The Earth Mover* contains a very interesting history of the wheeled scraper, entitled, "Put Wheels on a Dustpan."

* * *

The new 1916 edition of the "Road Builder's Guide" of the Austin-Western Road Machinery Co., has been published. Everything from road drags to motor road rollers.

* * *

## "The Sandwich Joint"

The most interesting section for road and street contractors and officials of the new booklet entitled "Architects' Specifications for Carey Building Materials," issued by the Phillip Carey Company, is the one on their Elastic Expansion Joint. This joint is fully described and the many illustrations show the adaptability of it to all classes of work calling for an expansion joint.

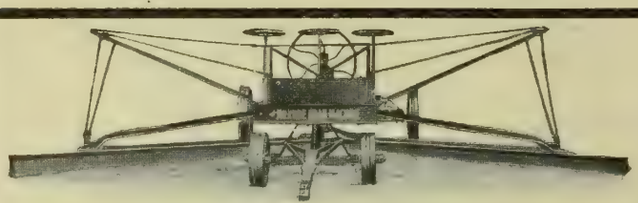
The book itself is unique in its make-up in that it is divided in several separate bulletins, any one of which can easily be removed for filing under any classification and is a very handy reference book for architects, engineers, contractors, officials, and prospective builders. It will be mailed to any interested person on request to the Phillip Carey Company, Lockland, Cincinnati, Ohio.

* * *

A new booklet entitled "Research on the Corrosion Resistance of Copper Steel," has just been issued by the American

A. H. Blanchard
M. Am. Soc. C. E. M. Can. Soc. C. E.
Consulting Highway Engineer
Broadway and 117th Street New York City


JAMES H. MAC DONALD
Consulting Road and Pavement Expert
Chamber of Commerce Bldg., NEW HAVEN, CONN
State Highway Commissioner of Connecticut nearly eighteen years.
Advice given on all phases of road building and street paving.
Consultations on specifications, materials and methods. Specialty of recommending efficient and economical equipment and plant Accurate estimates for contractors.


SEVEN SIZES FRONT VIEW
JUMBO DOUBLE BAR ROAD MACHINE
SCRAPES 30 FEET WIDE IN ONE OPERATION
BUILDS 12 TO 20 MILES OF ROAD PER DAY
N. S. MONROE & SONS ESTABLISHED 1894 ARTHUR, ILLINOIS

APOLLO-KEYSTONE Galvanized Sheets
Made from KEYSTONE COPPER STEEL—Unequaled
FOR ROADWAY CULVERTS
as well as for Roofing, Siding, Flumes, Tanks, and all forms of exposed sheet metal work. Demand APOLLO-KEYSTONE for your Roadway Culverts. Look for the stencil—it insures greatest durability and resistance to rust. Accept no substitute. Write for our free booklet showing actual service tests.
AMERICAN SHEET AND TIN PLATE COMPANY, - - - General Offices: Frick Bldg., Pittsburgh, Pa.

## An Economical Roadway of Proven Success!

# BITOSLAG

## An Asphaltic Concrete Pavement Manufactured by Special Process in Which Pulverized Slag is the Principal Mineral Aggregate

In 1910 there was laid in McKeesport, Pa., an experimental pavement composed of a specially prepared asphalt and a mineral aggregate of finely crushed slag and a good proportion of the usual dust or "filler."

After five years' service under heavy traffic and without any maintenance cost whatever, this experimental section remained in an unblemished condition, and proved in the opinion of many engineers and paving experts a roadway that was durable, economical, non-slippery and a most practical and successful method of utilizing a waste product, and at the same time insure those features so essential to the modern highway.

This new and successful pavement, which has received the name of BITOSLAG, can be laid on old macadam, concrete, old brick pavement, rolled broken stone or slag foundation.

The detailed specifications for the BITOSLAG wearing surface to be laid on the various types of base mentioned will be furnished on request. Our laboratories and engineering experts will be pleased to give full information as to preparing the mixture properly and testing same from time to time. This service is free to public officials and contractors to assist them to secure the best possible pavement of this type.

*Correspondence Invited as to Licenses to Lay this Pavement*

## BITOSLAG PAVING COMPANY

**90 West Street, New York, N. Y.**

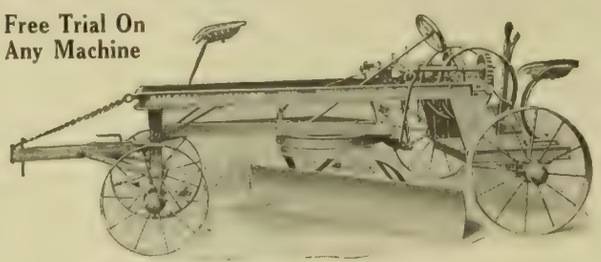
TELL 'EM YOU SAW IT HERE.

Take The Tip of the Judges at the San Francisco Exposition and Use

**Russell Road Machines**

Many Sizes Road Machines, Elevating Graders, Dump Wagons, Spreader Wagons, All Kinds of Plows and Scrapers, Road Drags, Corrugated Galvanized Metal and Cast Iron Culverts, Steel Beam Bridges, Etc.

Free Trial On Any Machine



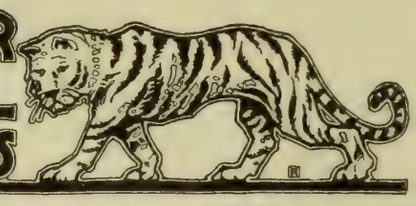
The Russell "JUNIOR"
Weight, 1600 lbs., 6 ft. Blade, Reversible

The "Junior" is built as a road maintainer. Works to good advantage with two or four horses. So simple to operate that a boy can handle it. For filling up ruts, crowning grades, clearing ditches, etc., it will be regarded as indispensable in any community after once used. Like our other machines, it is built largely of steel, nearly all parts forged, very few castings.

WRITE FOR BIG 1916 CATALOG

RUSSELL GRADER MANUFACTURING CO.,
2207-2229 UNIVERSITY AVE., S. E., MINNEAPOLIS, MINN.
Representatives in Principal Cities

TIGER STEEL BUNKS



These comfortable, sanitary, steel bunks can be set up and taken down without the use of tools or bolts—just like an ordinary bedstead. They are, however, equipped with a patented locking device, which makes a perfectly rigid frame. This insures a quick shift of camps. Gives your men clean, comfortable beds, which means much better work, and better men. Made in single or double decks in a wide range of sizes.



*Write Us for Particulars and Prices.*

Send for booklet giving inside information on good camp equipment.

HAGGARD & MARCUSSON CO., 1119 W. 37th St., Chicago

READY TO ERECT BUILDINGS



Made in sections. Quickly put up and taken down. Unequalled for Tool Houses, Shelter Sheds, etc. Solidly built to stand hard usage. PEERLESS PORTABLE BUILDINGS, composed of Interchangeable Units, are weather, wind, and waterproof. Any sized building to your order. Simply tell us your requirements. Prices right. Freight paid in North Central States.

PEERLESS BUILDINGS CO., 500 E. 40th St., Chicago

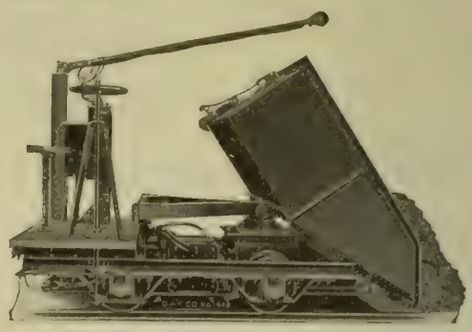
Sheet and Tin Plate Company. It shows recent and exhaustive experiments conducted by this company with various sheets of metal containing copper alloy. The American Sheet and Tin Plate Company, Frick Building, Pittsburgh, Pa., will mail copies of this booklet to interested persons upon application.

* * *

## Increased Efficiency in Waste Disposal

A material reduction in the cost of disposing of waste material is the purpose of a motor-driven, all-around dump car now made by the Orenstein Arthur Koppel Company.

Usually when handling this material, a track leads from under the waste track of the tipple to a dump, and ordinary mine cars hauled by mules deliver the material to the dump. These cars, however, are not self-dumping and a tipple is required for this purpose.



Under these conditions, the sides of the dump cannot be built up satisfactorily, as the material has to dump to the front and the tipple requires frequent moving. If the quantity of waste material is large and the haul is long, the expense is a noticeable operating cost factor.

A motor-driven car of the type mentioned does away with all the disadvantages of the foregoing method.

It can be handled easily by one man; the dump can be built up to both sides or to the end as desired; the speed of travel is relatively high and no special dumping mechanism is needed at the disposal point.

The dimensions of the car are: length over all, nine feet eight inches; width, five feet ten inches; height, four feet eight inches; and it has a capacity of fifty-four cubic feet. It is made in any gauge from thirty-six inch to standard and is furnished for either alternating or direct current.

* * *

That many city, village, and county officials and contractors are beginning to realize the enormous saving of time and money in the use of motor trucks in road and street work, is forcibly shown in three recent bulletins issued by the White Company, Cleveland, Ohio. This company has designed trucks for every purpose in road and street work as well as a combination sprinkler, flusher, and liquid asphalt distributor. More than 239 counties, municipalities, and States now own and operate White trucks successfully.

* * *

A new broadside folder entitled "Hauling Costs Reduced," descriptive of Knox tractors, and showing them in practically every use, has just been issued by the Knox Motors Associates, Springfield, Mass. Copy can be had on application to the company.

* * *

## Chicago Engineers Inaugurate Preparedness Campaign

A group of prominent engineers and contractors of Chicago and vicinity have co-operated in forming a Joint Committee on Military Engineering. The founders are members of all of the leading engineering and contracting organizations of Chicago, including the local branches of the national engineering societies.

The purposes of the committee are to further military preparedness among engineers, contractors, and their associates by the following means:

1. Courses of lectures.
2. Assigned reading.
3. Studies and practical instruction in military engineering.

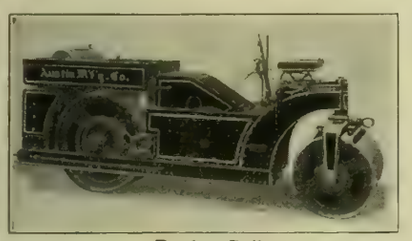
# Modern Municipal Road Authorities

demand as much uniformity and smooth working in their road and street equipment as they would in a well-selected fire fighting outfit.

## The Austin-Western Road Machinery Company

build an entire line of road and street machinery in their own factories. Each machine made under supervision of experts, all coöperating to produce the best and most suitable equipment for modern requirements. A well balanced, up-to-date Austin-Western road equipment works with uniformity and with the objects of efficiency and economy in view. Saving of time, money and trouble is the resulting service to the owner.

THE AUSTIN-WESTERN LINE INCLUDES:

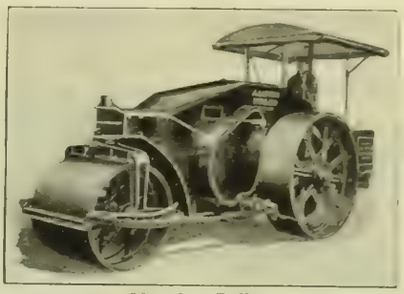


Tandem Roller

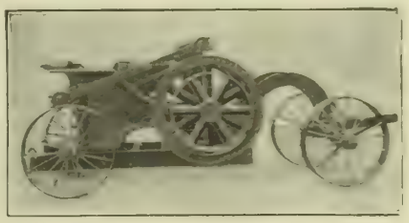


Oiler with Heater

**Motor Road Rollers,**
**Motor Tandem Rollers,**
**Road Scarifiers,**
**Rock Crushers,**
**Portable Stone Bins,**
**Stone Screens and Elevators,**
**Road Oilers,**
**Sprinklers,**
**Sweepers,**
**Stone Spreaders,**
**Dump Wagons,**
**Earth Handling Tools, Etc.**



Macadam Roller



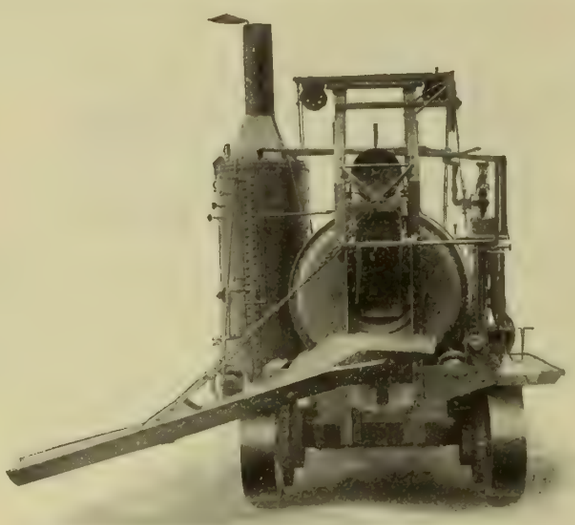
Jaw Rock Crusher

*Write for new edition of* ***Road Builder's Guide*** *now ready.*

# The Austin-Western Road Machinery Co.

## Chicago, Illinois

Agents and Warehouses Covering Every State in the Union.



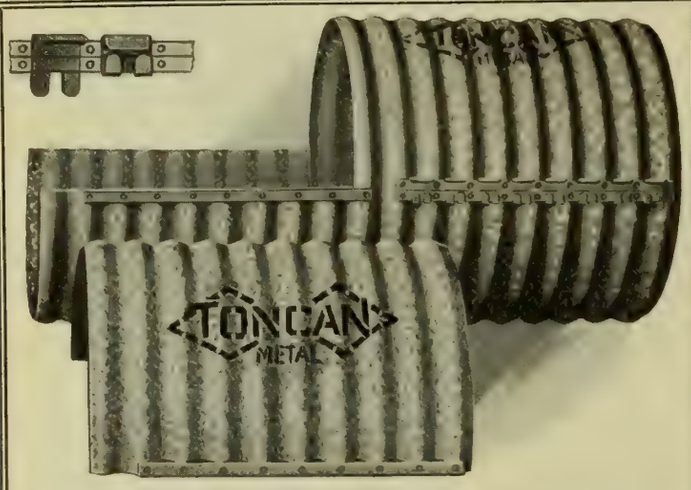
YOU SHOULD BE POSTED

There are exclusive advantages in MARSH-CAPRON PAVERS which every contractor should know about. There are three sizes to select from, END OR SIDE LOADERS, the most powerful traction, the easiest operation, profitably used with industrial cars, planking on the sub-grade not necessary, no lost motion, all levers within easy reach. COMPETENT AUTHORITIES SAY "THERE NEVER WAS A BETTER PAVER BUILT."

*Your name on our free list will bring you paver, mixer, and grouter data.*

MARSH-CAPRON MFG. CO., 1465 Lumber Exchange CHICAGO

Member of the National Association of Mixer Manufacturers.
Our Mixers Rated by the N. A. M. M. Wet Batch Rating.




*Here's Real Culvert Economy*

The real economical culvert is rust-resisting, non-breakable, easy to transport, install and remove, low in cost and maintenance.
Such a culvert is the

BUTT-JOINT NESTABLE CULVERT

*Made from*

Rust-Resisting TONCAN METAL Anti-Corrosive

SHEETS

Consider carefully the advantages of the Butt-Joint Nestable Toncan Metal Culvert. IT REPRESENTS TRUE ECONOMY.

*Write for Catalog*

THE BUTT-JOINT NESTABLE CULVERT CO.
826-828 REEDY STREET CINCINNATI, OHIO

TELL 'EM YOU SAW IT HERE.

4. Assisting engineers to qualify as officers in the National Reserve Corps of Civilian Engineers.

5. Urging enlistment in and support for engineer troops of the National Guard and such other organizations as the Government may create.

6. Furthering instruction in military engineering in training camps and the attendance in them of those qualified.

7. By such other means as from time to time may be deemed advisable.

The Joint Committee has already prepared a program covering the vital points outlined. To date, the program is practically complete for a period extending to July 25, 1916. Something of interest will be taken up each week, including lectures by Lieutenant-colonel W. B. Judson, Engineer Corps, U. S. Army; two lectures by Major P. S. Bond, Engineer Corps, U. S. Army; Lientenant-colonel Mason M. Patrick, Engineer Corps U. S. Army; and several exhibition drills, terrain exercises, and inspection trips under the direction and guidance of various officers of the Engineer Troops of the Illinois National Guard. Additions to the program will be made from time to time.

A correspondence course and practical work in field engineering and maneuvers by members of the Training Camp, will be organized during the summer.

Engineers, contractors, and their associates in Chicago and vicinity are invited to join the Joint Committee on Military Engineering. Correspondence should be addressed to the secretary, Robt. F. Hall, 111 W. Washington Street, Chicago.

The directors of the Joint Committee are; Chairman, Wharton Clay, Member Western Society of Engineers; vice chairman, Robert W. Hunt, Member American Institute of Mining Engineers; secretary-treasurer, Robt. F. Hall, Member Illinois Society of Engineers; Bion J. Arnold, Member American Institute of Electrical Engineers; W. W. DeBerard, Member Engineering Section, Chicago Ass'n of Commerce; J. DeN. Macomb, Jr., Member American Institute of Mining Engineers; H. S. Baker, Member Western Society of Engineers; Robert L. Randolph, Member Engineering Section, Chicago Ass'n of Commerce; and Vernon C. Ward, Jr., Member Chicago Engineers' Club.

The personnel of the directors and the lofty purposes of the committee itself insure the worth of the cause. Co-operation with the Joint Committee on Military Engineering offers excellent opportunity to Chicagoans to put into effect their desires to further the cause of preparedness, particularly with respect to the engineer, architect, and contractor.

* * *

## Integral Curbs Grow in Popularity

The integral curb for concrete streets continues to grow in popularity.

Winnetka, Illinois, a fashionable suburb of Chicago, will lay 1,680 square yards of reinforced concrete pavement on Spruce Street, and 2,600 square yards on Pine Street, this year. Both streets will be twenty-two feet wide with integral curbs. Specifications call for a 1:2:3 mixture. Windes and Marsh, village engineers of Winnetka, will be in charge of the work.

Recently, the Village Board of Glenellyn, Illinois, passed an ordinance calling for 43,520 square yards of reinforced concrete paving to be laid on a system of streets in the south side of the village. Specifications call for a base of one part cement, 2½ parts sand, and 4 parts pebbles or stone, and a top course of a 1:1:1½ granite mixture. Integral curb will be laid with all pavements. Last year, Glenellyn awarded contract for 35,000 square yards of concrete pavement, most of which was completed in that year. Jas. E. Simons, mayor, George G. Nelson, city engineer, and R. G. Hammond, compose the Board of Local Improvements.

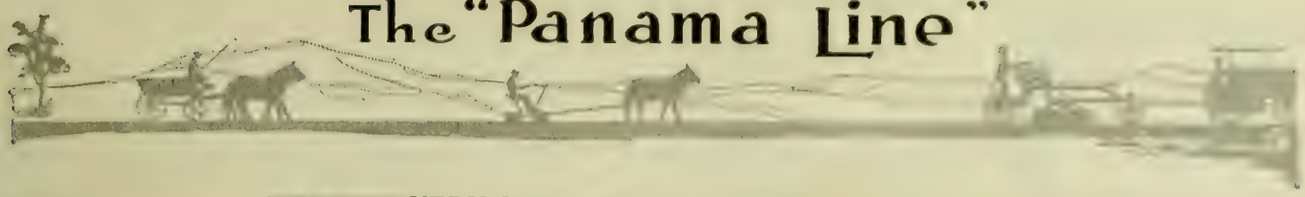
Milwaukee, Wis., now has 30,000 square yards and East Milwaukee 80,000 square yards of concrete pavement with integral curb. Scores of other examples could be cited.

* * *

## Engineers' Welfare Organization Making Good

Good engineers are needed by the co-operative Service Clearing House of the American Association of Engineers, to

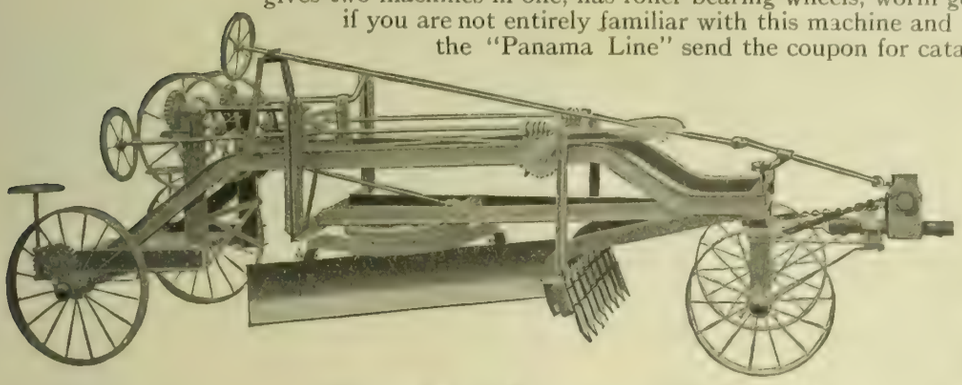
# The "Panama Line"



*"Panama Giant"*

EVERY ONE accepts the word "Sterling" as guaranteeing top-notch quality in silverware. Likewise to hundreds of road contractors and officials, the words "Panama Giant" immediately suggest the paramount quality in road machinery. The "Panama Line" has been built **up to a high standard** and their high reputation won by sheer merit.

The "Panama Giant" is a big, strong machine, embodying all the general good points of approved road machine construction, together with several exclusive valuable features. It is furnished, when desired, with a scarifier, which really gives two machines in one, has roller bearing wheels, worm gears throughout and. . . . but, if you are not entirely familiar with this machine and the several others comprising the "Panama Line" send the coupon for catalog.



MAIL OR USE FOR MEMORANDUM

The F. B. Zieg Mfg. Co. Fredericktown, Ohio.

Gentlemen:-
Send your catalog as offered in Better Roads and Streets.

Name.....

Address.....

PANAMA LINE ROAD MACHINERY

THE F. B. ZIEG MFG. COMPANY
*Fredericktown, Ohio*

# WHEELING
## CORRUGATED METAL
# CULVERTS
## MADE OF PORTSMOUTH IRON

*Make Bad Roads Good*

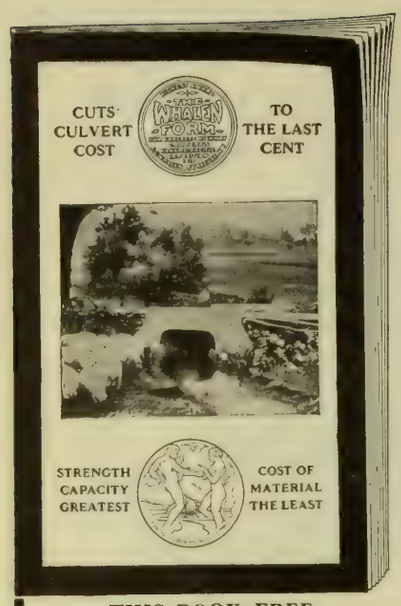


WHEELING CORRUGATING COMPANY, WHEELING, W. VA.

BRANCH OFFICES AND STORES:

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SPECIFIED BY LEADING ENGINEERS




THIS BOOK FREE

side front cover is shown above Now get busy with coupon below.

# PROOF!

YOU Road Builders are, or should be interested in culvert construction. The most vital question in road building today is, NOT what type of material to use for the surface of the road, or what make of machinery to do the work—but **the one biggest thing in all road construction is, or ought to be, Drainage!** How to get the most water across the road at the least expense and through the most permanent structure—is a question worthy of the best of you.

A NEW BOOK HAS BEEN WRITTEN ON CULVERT CONSTRUCTION. And this book is FREE to interested readers of Better Roads and Streets. The man who compiled the information contained in it probably knows more about this subject than any man in America today. Yet it is all given to you **free for the asking.** The only request is that you mention that you saw this ad in Better Roads and Streets The book does not confine itself to theories—but **is full of facts and figures.** Even if you do not agree with all that is written—tho that is not likely—you will still find the book full of intense human interest. **It will open your eyes** —if it does no more. This is **not** a catalog—it is a free BOOK on the subject of CULVERTS. A cut of the out-

SALESMEN WANTED FOR

## THE WHALEN FORM

**401 Vinney Building, Syracuse, New York**

**Use Coupon Below at Once and Get Your Copy of This Book Free Today.**

**Fill out and mail today the Coupon below addressed to The Concrete Form Co., Inc., 401 Vinney Bldg., Syracuse, N. Y.**

*Send me at once postpaid, and with no charge or obligation, a copy of your new Culvert Book*

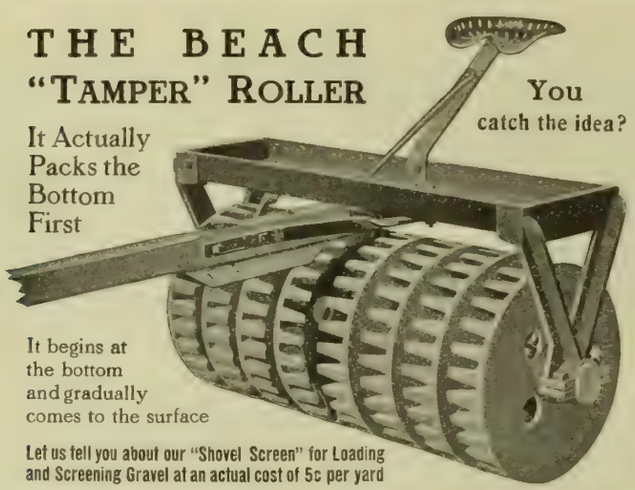
*Name* _____ *Business or Official Title* _____

*Address* _____

## THE BEACH "TAMPER" ROLLER

It Actually Packs the Bottom First

You catch the idea?



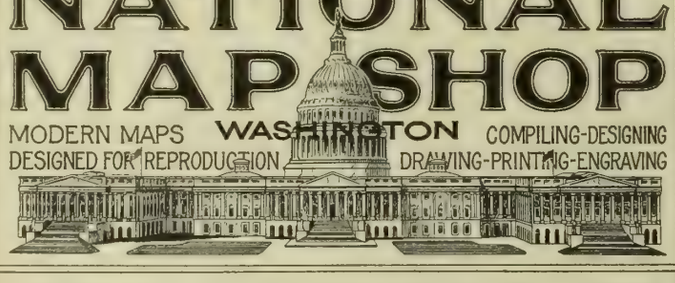
It begins at the bottom and gradually comes to the surface

Let us tell you about our "Shovel Screen" for Loading and Screening Gravel at an actual cost of 5c per yard

**Beach Mfg. Co., 30 Beach St., Charlotte, Mich.**

## NATIONAL MAP SHOP

MODERN MAPS DESIGNED FOR REPRODUCTION




COMPILING-DESIGNING DRAWING-PRINTING-ENGRAVING

**Attractive maps talk! If you want YOUR map, plat or diagram to get an AUDIENCE, you can't afford to overlook this point. Tell us what you want and let us give estimates and samples. ROAD MAPS FOR BLUE PRINTS OR LINE CUTS A SPECIALTY**


fill positions that are referred to them by employers in all parts of the United States.

Business is being done on a large scale by this association, which started in September, 1915. At present, there are four hundred certified members. An additional one hundred and fifty engineers have made applications and are being transferred to the certified class as fast as their qualifications can be verified. Official data on activities from March 1 to 25, 1916:

| | |
|---|---|
| Applications received for members | 92 |
| Open positions reported | 50 |
| Members applying for positions | 32 |
| Non-members applying for positions | 6 |
| Positions filled | 15 |
| Positions on list unfilled | 30 |
| Members unemployed (March 25, 1916) | 4 |

The positions on the unfilled list range from $1,200 to $5,000 per year, and some of them have been open for several days because the list of engineers on file desiring positions is very limited. If all engineers in America knew of the benefits they could confer upon their profession as well as gain in a personal way from this great movement of co-operation, it is believed that the lists would soon be filled with progressive engineers of high qualifications who would "advance and co-operate" with the association.

The association tries to discourage its members from changing positions unless obviously they are underpaid or unless they are better fitted for work other than that on which they are engaged. Unnecessary changes are expensive in time and money both to the employer and to the employee.

* * *

## Installing Universal Concrete Bars

An illustrated folder describing, in detail, methods of handling and installing Universal protection bars in concrete curbs



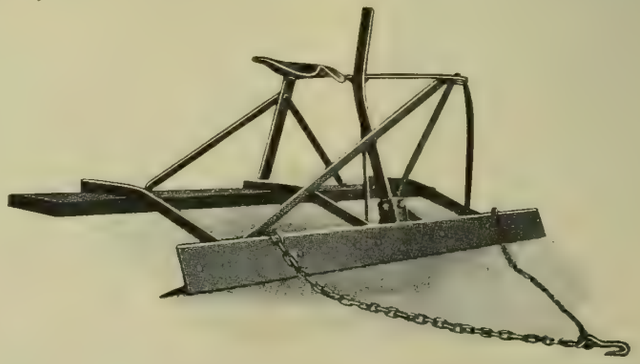
**Setting a Corner Bar in Curb at Street Intersection**

and at joints in concrete roads, has been issued by the Universal Concrete Bar Co., Chicago. A table of weights and lengths and instructions for ordering is included.

* * *

## New Monroe Road Drag

An improved type of road drag has been brought out this year by N. S. Monroe & Sons, Arthur, Ill. The principal im-



provement consists in the control of the front blade. Instead of tipping forward when it is desired to smooth rather than

# *With Gasoline at 25 Cents a Gallon Would a Gasoline Shovel Be Profitable?*



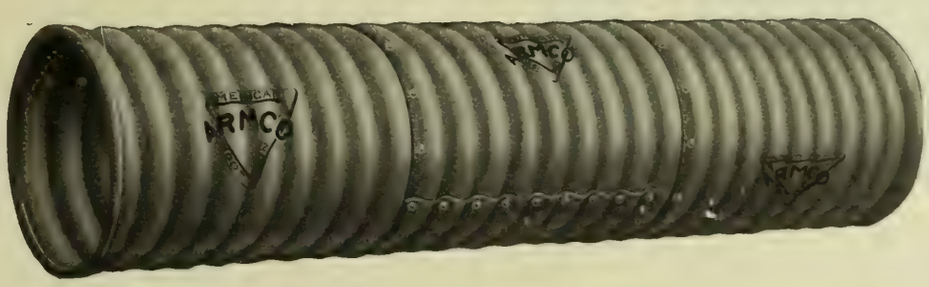
The owner of **The Thew Gasoline Shovel** shown in the cut writes: "I would have lost money on this contract if I had used anything but a Gasoline Shovel. The hauling of coal and water for a Steam Shovel would have cost more than the cost of the gasoline consumed. I would also have been forced to keep a watchman on the shovel to keep the pipes from freezing. The material was difficult—some of the stones shown in the cut contained 3 cu. yds. The machine has given us no trouble and I am more convinced than ever that the **Thew Gasoline Shovel** is **the coming Shovel.**"

Suppose you do use 20 gallons of Gasoline at 25 cents per gallon—a total fuel cost of $5.00 per day—you save a fireman—one man on The Thew will operate it to the limit of its capacity and your total cost of loading from 300 to 600 cu. yds. per day would be less than $15.00. **Can You Beat It?** Remember, THE THEW GASOLINE SHOVEL has long ago passed the experimental stage and is absolutely reliable.

*Write for Circular 24-B. It Will Pay You.*

**THE THEW AUTOMATIC SHOVEL COMPANY,** LORAIN, OHIO

Purity

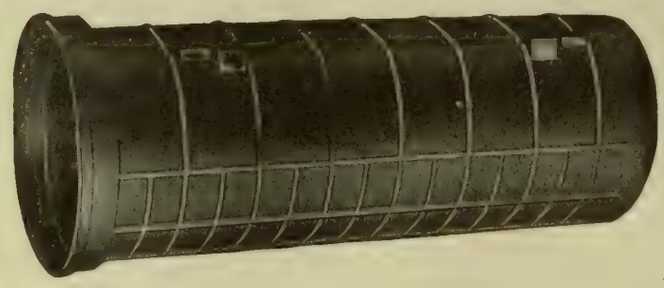



Permanence

# SAVE TIME—SAVE MONEY

USE THE

## Burch Expansion Cast Iron Culvert Pipe



8 to 48 inches diameter, 3 and 4 ft. lengths. Half sections which lock with lugs.

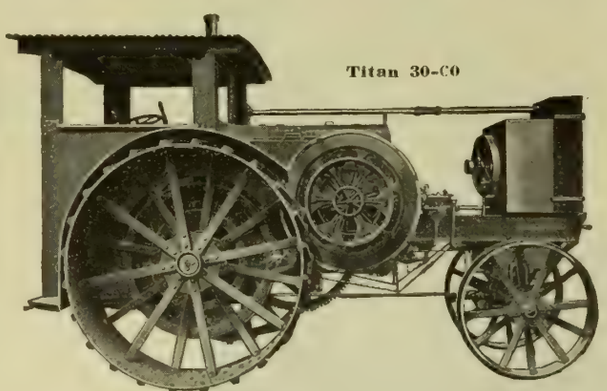
Provides for expansion and contraction. Easy to handle and lay in ditch. Requires less excavation. Strong and durable. Send for Catalog "F" giving full description of complete line.

**THE BURCH PLOW WORKS CO.**

CRESTLINE, OHIO



## Kerosene Power Cheapest for Road Work




How much more money would you make for yourself or for your community if you found a way to cut 25 per cent. off your present cost of grading roads? If you are still using horse or mule power, we can show you a way to save even more than that. If you are using a gasoline tractor, we can still show you how to make a profitable saving.

Every dollar you cut the cost of road grading is a dollar added to your net profit. We can put you in touch with one man who says he cut the cost of road grading in Louisiana from $26.00 PER MILE with mule power to $4.50 PER MILE with MOGUL kerosene tractor power. His figures are in the official records of his parish.

That is probably an extreme case, but the fact that so large a saving as this could be made, is interesting. It suggests that possibly your costs are higher than they need be. Perhaps a little investigation would pay. Would you like to see some of the figures we have collected—some of the savings we have helped other contractors and road builders to make by changing over to MOGUL or TITAN kerosene tractor power? They'll cost nothing but a two cent stamp and a little time. Write for them.

**International Harvester Company of America**

(Incorporated)

152 Harvester Building CHICAGO, U. S. A.

TELL 'EM YOU SAW IT HERE.


scrape the surface, the new drag tips backward and the smoothing action is done by a blade riveted at right angles to the cutting blade. Notches for the lever handle hold the blade in any one of three positions.

The regular length of the machine is eight feet, and two or three horses are required to operate it. It is built of steel throughout. Special lengths are made to order.

* * *

## Macadam Road System of Franklin Co., Ohio

(*Continued from page 7*)

and that they (the County Commissioners) did not propose to buy any more this year.

Well, it happened that, late in March, Jones happened to drive out past the county shops, and was amazed to see five "new" Adams machines standing there. There was a record-breaking aëroplane ascension in his mind at once, and he opened up all the power there was in his little Tin Lizzie and made for the offices of the County Commissioners. Smith happened to be in the office alone at the time, and Jones did not lose any time in opening up on him. Smith let Jones go the limit before he said a word, and then answered him as follows: "Jones, always be sure you are right before you go ahead; and when you know you are right, then go. I told you we did not intend to buy any new machines." But here Jones ascended again and told Smith that he had seen five new machines of his competitor's make, lined up in front of the shop building, and that he had seen them with his own eyes; and that when he saw a thing with his own eyes not even one of his friends could convince him that he had not seen what he knew he *had* seen. Smith replied: "Jones, the maintenance season is coming on, and we may have a lot of good weather in April. When our men have nothing much to do in the winter, they overhaul our equipment, paint it, and get it in the pink of condition for the battle that it has to go through the following summer. Those Adams machines that you saw out there have been freshly painted. They are the same old machines that we used last year, and as we have not purchased, and do not intend to purchase, any more road machines, I think that the dinner this evening and a little theater party for two is on you."

The writer learned of the story that evening when he met the pair at a popular musical comedy that was playing in Columbus. The story illustrates, however, the care that is given to the county equipment, instead of doing as many owners of such equipment do—let it lie out in a field or along a road somewhere exposed to the weather, until it is wanted again in the spring.

The following equipment is owned by Franklin County:

Five road rollers, all of the three-wheel type. These consist of one Kelly-Springfield twelve ton and two Kelly-Springfield ten-ton rollers, one Monarch ten-ton and one J. I. Case ten-ton roller.

Five King graders and scarifiers, manufactured by the J. D. Adams Company.

Five water wagons with sprinkler attachments, furnished by the J. I. Case Threshing Machine Company.

Two machine brooms for cleaning water-bound macadam prior to the application of bituminous surface treatment, furnished by the Good Roads Machinery Company.

One large portable tar kettle, furnished by the J. D. Adams Company.

Portable gasoline-driven water pumps mounted on trucks.

The county also owns a considerable amount of small equipment, tools, etc., so that the forces are never hampered by the lack of the proper tools with which to make needed repairs and to attend to maintenance of any kind.

Franklin County is paying a great deal of attention to the proper marking of her roads, and also marks the county line on all county roads. The signs used are of the most permanent and durable type, being of the drilled in style, manufactured by the Indestructible Sign Company of Columbus, These guide signs are erected on concrete posts which stand twelve feet and nine inches above the ground. In addition to these signs, the county also erects a sign near each corporation line on each county road, so that travelers may at all times know what city or town they are entering or leaving. All distances given on the signs are from the center of the city named, and not from the corporation line.

The bridges of the county are generally in excellent condition. All old structures are being replaced as rapidly as possible and available funds will permit. There are 110 large bridges and over six thousand small bridges and culverts in the county. There are still twenty-two of the old, covered, wooden bridges in the county.

On the new cross-section being used this year, Franklin County is constructing a well-defined ditch on each side of the road. The slopes are 1½ to 1, and these ditches have a minimum depth of eighteen inches, while they are two feet in width at the bottom. The center line of the ditch is seventeen feet from the center of the road and the roadway itself is twenty-eight feet in width. On this roadway is constructed a metalled or paved surface sixteen feet in width with a six-foot shoulder on each side. There is a five-inch crown on the metalled portion of the roadway and the shoulder is fourteen inches below the center line of the metalled roadway. The macadam courses are, as before, being constructed five inches thick for the bottom and four inches thick for the top.

The officials in charge of road work in the county have decided to give about fifty miles of the water-bound macadam a bituminous surface treatment this year, as they have come to the conclusion that this will prove a most economical method of preserving the road, as well as keeping down the dust.

The Commissioners of Franklin County are Thomas E. Humphreys, Richard Sinclair, and Levi E. Douglass. John Scott is clerk to the Commissioners; John Peake is county surveyor; Curtis C. Latimer is deputy county surveyor in charge of road construction, maintenance, and repair, and Walter Braun is bridge engineer. There are twenty-one men in the engineering force of the county, and during the construction season there are regularly employed from ten to fifteen inspectors on road construction, repair, and maintenance.

* * *

## Factors in Construction of Bituminous Pavements

(*Continued from page* 10)

practice requires the screening of the aggregate into several compartments and sizes, the number of operations depending upon the complexity of the aggregate.

In most plants, this is not accomplished with sufficient accuracy or with sufficient provision against contingencies which arise during plant operation. Frequently the storage bins upon these plants are small and when subdivided into compartments the operating screen is too short to make a clean separation. Sometimes the partitions are light and do not come up sufficiently around the screens, and when one bin becomes filled, while the adjoining one is nearly empty, there is enough deflection in the partitions to move them beyond the line of division of the screen, permitting one bin to catch aggregates which should drop into the other. Frequently also, if the plant is not taking material as fast as it might, or if the feed has been varied, one bin will fill up and in the absence of an overflow spout from *each individual compartment,* material from one bin will crowd over into the next.

It follows, in any case, that in weighing out aggregate from different bins, the proportions set are departed from and variable aggregate discharges into the mixer, for which the amount of asphalt cement may be entirely unsuited. To correct this condition, it is necessary, when it occurs, to stop the work, empty out the bins, thereby interrupting the smooth operation of the plant and causing disturbances in other directions.

This occurrence is a most frequent one at paving plants, and is the cause of much unnecessary trouble and irregular mixture. In fact, it sometimes becomes so troublesome that it is often advisable not to make a screen separation of aggregate, but to regulate it as closely as possible at the cold elevator. Unless this screen device is so constructed as to operate without causing contamination of the various aggregates with each other, it becomes a source of constant danger. It should be a comparatively simple matter to design this separating unit so that it will actually perform the work for which it is intended.

### MIXING

After the aggregate has been separated into its components and delivered to the storage bins at the proper temperature, the next and most important step is the combination of the various elements into the final pavement mixture.




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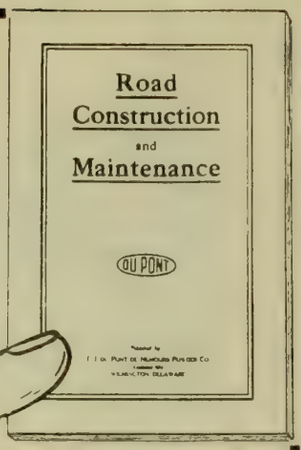
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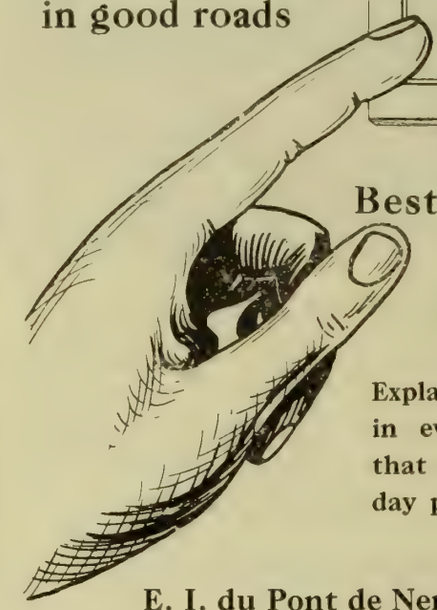
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Until recently, it was common practice to measure the aggregate by volume, either in a box of constant capacity or by striking off an open measuring box. The writer has frequently observed these boxes of constant capacity operating with upper and lower slides, which would not permit shutting off from the bin without first opening the discharge. As a result, a considerable quantity of material over the theoretical capacity frequently passed into the mixer before the upper slide was shut off.

In one case which resulted in a dispute of binder yardage, it was found that the amount of binder actually turned out was twenty per cent. in excess of the capacity of the measuring device just on this account.

The use of open boxes for measuring is open to the objection that it requires striking off by the laborer, and this, in the long run, is slighted. Measuring devices of this kind, as well as volume measurements of asphalt cement, are fortunately almost a thing of the past, and it is now customary upon the most modern plants to weigh these various ingredients. Unfortunately, however, the class of labor available for this purpose cannot generally be depended upon for accuracy even in so simple a matter as weighing, and the result frequently is in error, owing to overdrawing of weights, changes of tare, and errors in handling weights.

All of these weighing operations should be carried out automatically, with weighing devices attached to hoppers which would automatically shut off from the storage bins upon being filled to the required weight. This is common practice in cement and flour mills and in many similar applications.

The automatic scales on the asphalt cement bucket should be of a kind which would operate somewhat differently. This should be devised in such a manner that the given amount of asphalt cement will be discharged from the bucket regardless of its tare. This would eliminate the greatest source of error at the mixer, and would result in uniformity of the product of the plant.

It is believed that the foregoing accounts form a very considerable amount of defective or partially defective work which sometimes results in spite of the best of intentions on the part of the paving contractor and his employees. It is further believed that the manufacture of paving mixtures should be facilitated by applications at least equally effective as those available for processes of similar importance.

The plant manufacturer who devotes attention in the future to such details will do much toward forwarding the interests of the asphalt paving industry, and his efforts will be appreciated by all responsible for the success of the product of these paving plants.

* * *

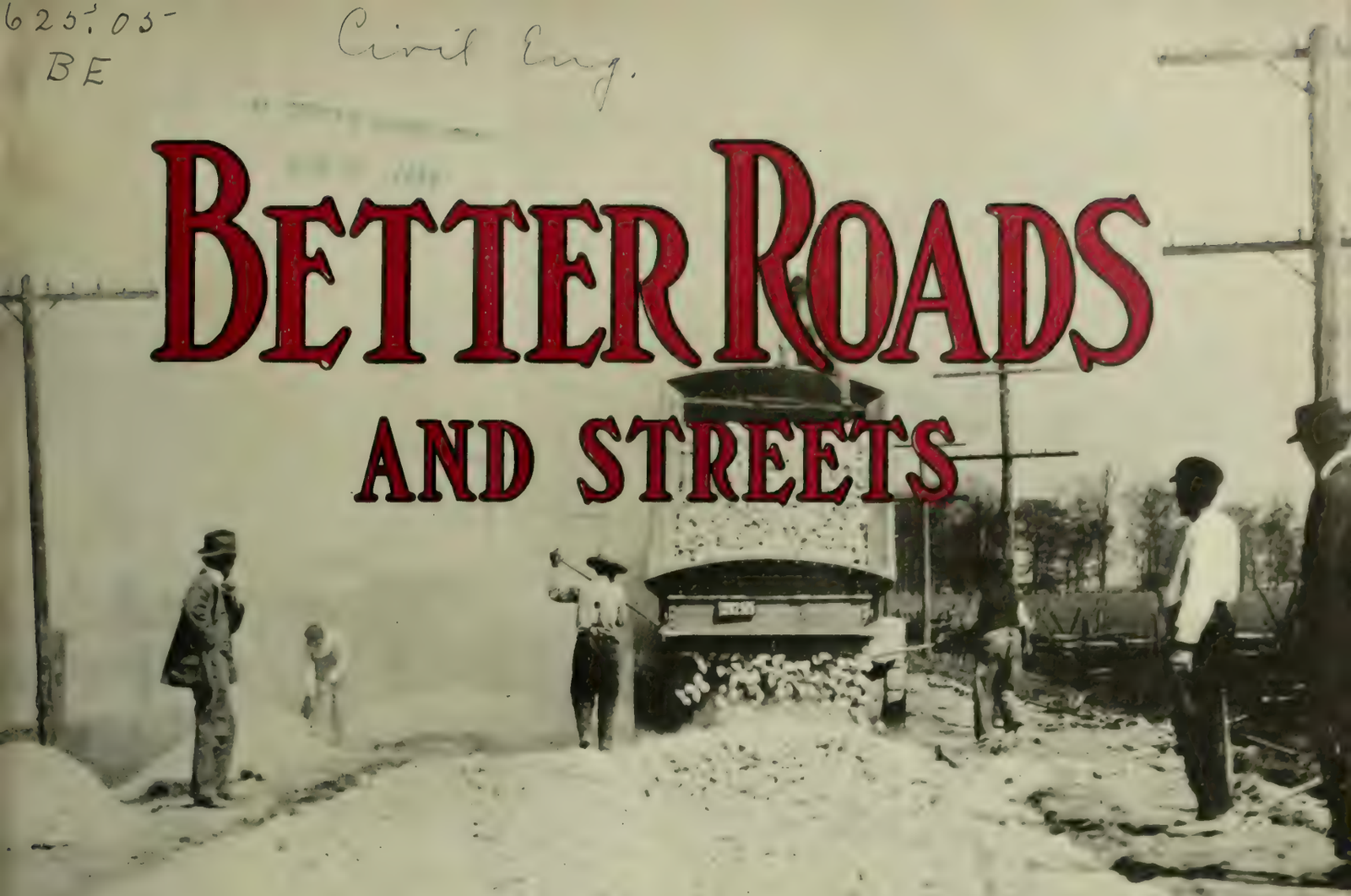
It is now May. Let us all pitch in and assist in cleaning out our side ditches. Do this and give the water a chance to get away from the road. Water doesn't want to stay so close to the road that it will get under it and over it. The water would, in every single case, if permitted to run its own course, run away from the road and down hill. Did it ever occur to you that every well-built and well-maintained roadway surface has at least two hills, seemingly to let the water do what it wants to do? This is a fact, and these two hills run from the center of the road toward each side ditch. If the surface of the roadway is flat, it is a mistake to call it a good road. After cleaning out the side ditches, do not forget that there is something else that is very important to look after. This is the trimming of the shoulders so that they will not form dikes and prevent the water from running into the ditches where it belongs.

* * *

The "economics of guarantees of pavements on State and Municipal Highways" was fully discussed by George C. Warren, President of Warren Brothers Company, of Boston, Massachusetts, in a lecture delivered by him before the graduate class in Highway Engineering at Columbia University on January 24, 1916 in the assembly hall of the Automobile Club of America, New York City. The four principal points made most prominent by Mr. Warren were, Historical, Legal, Practical, and Specifications. It is a most interesting paper and engineers and officials should procure a copy and read it carefully. The paper in full has been printed in pamphlet form and copies of it may be secured, without charge, on application to Warren Brothers' Company, Boston, Massachusetts.

625.03
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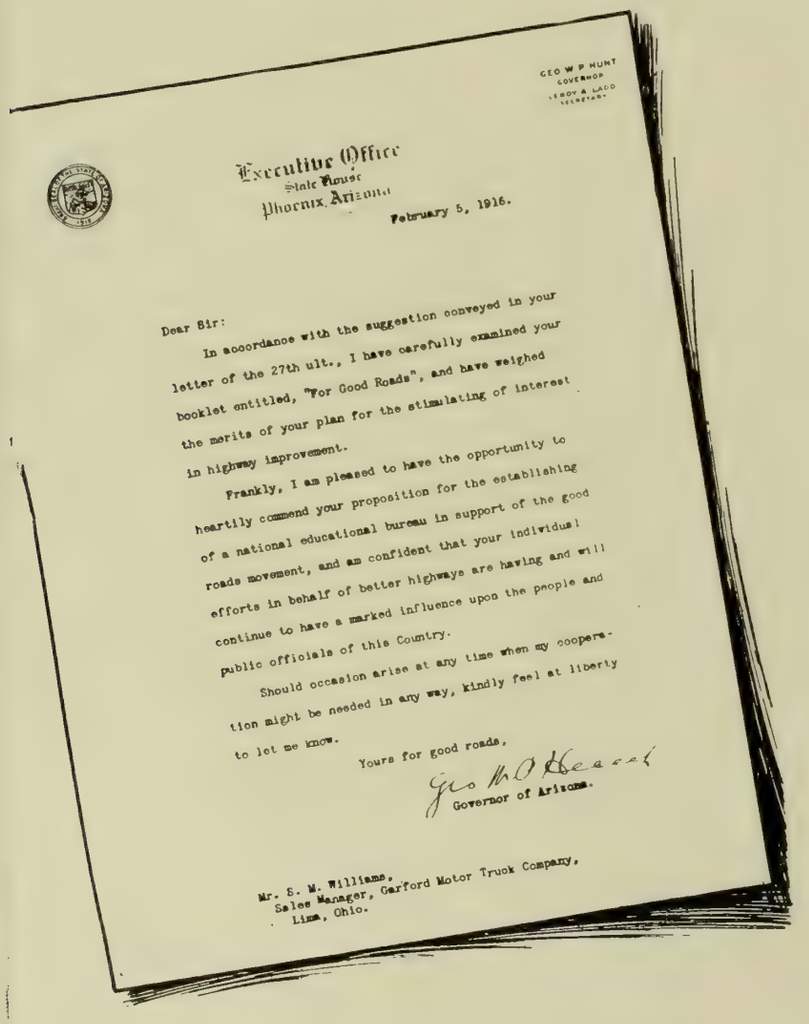


JUNE, 1916.

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GEO. W. P. HUNT
GOVERNOR
LEROY A. LAGO
SECRETARY

Executive Office
State House
Phoenix, Arizona

February 5, 1916.

Dear Sir:

In accordance with the suggestion conveyed in your letter of the 27th ult., I have carefully examined your booklet entitled, "For Good Roads", and have weighed the merits of your plan for the stimulating of interest in highway improvement.

Frankly, I am pleased to have the opportunity to heartily commend your proposition for the establishing of a national educational bureau in support of the good roads movement, and am confident that your individual efforts in behalf of better highways are having and will continue to have a marked influence upon the people and public officials of this Country.

Should occasion arise at any time when my cooperation might be needed in any way, kindly feel at liberty to let me know.

Yours for good roads,

Geo W P Hunt
Governor of Arizona.

Mr. S. M. Williams,
Sales Manager, Garford Motor Truck Company,
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That was less than a year ago.

Since then, requests have been received from Good Roads Associations, Chambers of Commerce and influential men, for nearly **half a million copies of this booklet** for use in Good Roads campaigns in all sections ot the country.

Many expressions of approval and encouragement have been received from men prominent nationally and in their various localities. The letter from Governor Hunt of Arizona is typical of their tone.

You, too, will be interested in our book. A copy will be mailed free upon request. Please address Dept. 100.

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# Better Roads and Streets

VOL. VI. NO. 6 JUNE, 1916 PRICE FIFTEEN CENTS

## Annual Meeting of the Michigan Good Roads Association

THE regular annual meeting and convention of the Michigan State Good Roads Association was held May 10 to 12, inclusive, at Battle Creek, Michigan, the official headquarters of which were at the Post Tavern. The business sessions were held in the Post Theatre, and the exhibits were placed in a large test a few hundred feet away at the corner of Jackson and McCamly streets.

There were about five hundred road enthusiastis in attendance, and it was pointed out by those in position to know that almost without exception, those who attended the convention this year were actively identified with the movement for better roads in some form or another. And this fact, combined with the prominent speakers at the various sessions, is unanimously stated by the officials and members of the association as being responsible for what was, without question, the best and most beneficial meeting that has yet been held by the Michigan State Good Roads Association.

Although the business sessions did not open until Wednesday morning, a large number of the delegates arrived on Tuesday evening, when several informal meetings were held, and road matters and road conditions throughout all parts of the State were gone over.

The official headquarters were opened early Wednesday morning for registration, and the first business session was called to order promptly at ten o'clock with the Hon. Phil T. Colgrove, Hastings, Michigan, President of the Michigan State Roads Association, in the chair. After the invocation by the Rev. W. J. Lockton, and greetings from the city of Battle Creek by Mayor James W. Marsh, of the latter city, a response and the president's annual address were given by President Colgrove. This address was most interesting, and was prepared in advance in printed form for distribution among the delegates.

Mr. Colgrove then introduced Governor Woodbridge N. Ferris, of Michigan, stating that he "is the governor who has done everything for good roads and for better roads that he has been asked to do, and that he has been the most faithful of all the governors in working for the cause of better roads." The following pertinent paragraphs are extracted form the address of Governor Ferris:

"I am interested in good roads only for the good that they can do. We have hundreds of little schools scattered over the State, with only a few pupils attending them. Good roads make it possible for us to centralize our rural schools, with better teachers and generally better facilities."

"Good roads also bring up the value of farm lands in the State and give the farmers a chance to get something out of life. They are the means of giving people recreation, and although I am a disciple of work, I believe in the right kind of play. When a man forgets how to play, he is the deadest thing there is on earth."

"Good roads are an aid to religion and good roads also are an expression of the highest form of patriotism. It is the kind of patriotism which involves the interest of others, and that kind of patriotism is not common."

Governor Ferris then urged that some kind of definite action be taken to encourage communities to maintain and care for the roads that have already been built, and that it would be a good investment for all automobile owners if the present tax on automobiles were doubled, provided all the tax would be spent in maintaining the roads.

Governor Ferris closed his talk by advising all present to "go out on the highways and byways, as many of our people are asleep on the good roads question, and a resurrection is badly needed."

The balance of the morning session was devoted to addresses on "The East Michigan Pike," by Harry L. Nichols, Secretary of the Good Roads Committee of the Detroit Chamber of Commerce; "The Things Battle Creek Stands For," by Joseph L. Hooper; the reports of the secretary and treasurer of the association and the appointment of committees. These committees were as follows:

Nomination of officers. Frank F. Rogers, State Highway Commissioner, Lansing, Michigan; A. B. Williams, President of the Michigan-Detroit-Chicago Paved Way Association, Battle Creek, and Dallas Boudeman, Kalamazoo.

New constitution and by-laws. N. P. Hall, Lansing; John Lentz, Monroe, and W. M. Bryant, Kalamazoo.

The morning session closed with a meeting of the officers and the board of trustees of the Michigan Good Roads Association.

A band was on hand and opened the session in the afternoon by rendering several selections.

The first address of the afternoon was by M. O. Eldridge, Assistant in Road Economics, Office of Public Roads and Rural Engineering, United States Department of Agriculture, Washington, D. C., who had selected as his topic, "What the Government is Doing for Good Roads." Mr. Eldridge's talk was well illustrated with moving pictures and with slides, and was of far more than ordinary interest to all present, as was attested by the applause the speaker received.

In his talk, Mr. Eldridge dwelt at some length on the subject of maintaining our roads after they have once been built, and pertinently stated that if a railroad used the same system of maintenance as prevails with the average authorities controlling an improved road, the locomotives would soon be unable to make a run of a hundred consecutive miles.

He further stated that road districts, in Michigan or elsewhere, which attempt to improve roads and to build up road systems without the services of a competent engineer are simply wasting their money. Another point that was brought up, and which should receive the hearty support of every road official was the advertising sign nuisance. Mr. Eldridge advised that all advertising signs and all billboards along improved roads be removed in order to provide more attractive landscapes.

In discussing types of roads to use, he said that no one material nor no one method could be used or recommended, as everything depends upon the cost of the material, the nearness of the source of supply, the traffic, natural topography, etc. At the conclusion of the talk, the author showed several reels of motion pictures, showing the construction of broken stone roads in Maine, and the construction of the twenty-four miles of concrete roadway on the National Pike in Licking and Muskingum Counties, Ohio, in all of which construction the Government participated.

The next address was also of more than ordinary interest—"Road Maintenance," by W. W. Cox, District Engineer of the Michigan State Highway Department, Kalamazoo, Michigan. Mr. Cox stated that the patrol system of maintenance is now making great strides in many parts of the country, and is rapidly supplanting the spasmodic gang system of maintenance. He urged that all weeds, brush, and grass along improved roads be cut regularly as this would, in almost all cases, insure a clear view for a hundred and fifty feet. In taking up the question of drainage, he stated that proper drainage is the greatest need in the construction of improved roads. He also recommended that townships and counties in building their roads, put in the driveways connecting with the roads. The Michigan Supreme Court, he stated, has ruled that this is up to the prop-

erty owner, but that for the best and most uniform results, this is not the best practice. He also stated that the most important part of the road work in his State, as well as in other States, is in keeping up the appearance of the road, as the taxpayers will almost always be found to be more willing to make further investments when the appearance of the road is kept up by cutting the brush, keeping in repair the guard rails, etc.

Dragging, he said, is usually done too late in the season, and too long after a rain. To secure the best results, the roads should be dragged shortly after a rain while the material is still wet and will bind. Every effort should be made by those in charge of the roads to have a clear view of from two hundred and fifty to three hundred feet on curves. Ditches should at all times be kept open and ample chance should be provided for the final escape of the water from the side ditches.

W. S. Gilbreath, Field Secretary of the Dixie Highway Association, Chattanooga, Tennessee, was the next speaker, and explained in considerable detail what has been done, and what has been planned on this important highway from Miami, Florida, to the Straits of Mackinaw. He stated that the Dixie Highway has had more to do with the good roads movement in the South than any other one factor, and showed how some of the South's impassable highways have been and are being replaced with brick and concrete highways which enable motorists and farmers to cover in a few hours what formerly required many hours and even days to cover.

The session on Wednesday evening consisted of three excellent talks, and was under the auspices of the Michigan-Detroit-Chicago Paved Way Association. Arthur B. Williams, President of the Association, Battle Creek, delivered an excellent address on "Good Roads as a Factor in Community and Character Building." An abstract of this talk will be published in the July issue of Better Roads and Streets.

The Hon. John W. Boardman, Jackson, Michigan, spoke on "Shall We Continue to Appropriate Money for Temporary Improvements of Trunk Line Roads?" Mr. Boardman is county supervisor in his county, and spoke from practical experience on his subject. He stated that the cheapest road for the main trunk-line highways is the concrete road, or some other so-called parmanent type. He told of his experience in gravel road construction along the territorial road, and presented some figures in support of his contentions.

The following quotations are from Mr. Boardman's talk, and are of interest:

"I think that ninety per cent. of the people now want good roads, but just at present the question is what kind of a road shall we build?

"I have attempted to get figures from every county along the route of the Detroit-Chicago Paved Way, but the records were not available, so I have had to confine myself to the figures of my own county.

In 1913, Jackson built a mile east on the main territorial road, at a cost of $11,169, and this year we are practically rebuilding that road, making a total cost to date of about $16,000. The road west of Jackson, built at the same time, cost $6,175, and the total cost so far has been about $17,000.

"We are drifting to the point where there will be no new roads constructed, as all the money will be required for repair work on the roads that have already been built. Bonding the county is a great undertaking and carries great responsibilities, but I think bonding is justified to build a permanent and lasting system of roads. Therefore, let us get down to business and construct a lasting road along this great highway. And I believe it just to the next generation, which will enjoy its benefits, to assist in paying for the construction of such a highway."

Mr. Boardman then showed how the road question is the most important to the farmers, as the farmer hauls the greatest tonnage over the roads. He stated that the saving on hauling fifty tons—the average annual yield from a forty acre farm—to market over good roads, would more than pay the increased road tax that would be assessed against the farmer.

The closing address of the evening was "Permanent Road Construction Experience in Milwaukee County," by C. C. Jacobus, Chairman of the Committee on Highways and Bridges of Milwaukee. He related some of the experiences in the construction of permanent highways and roadways in Milwaukee County—types that are being advocated for the Detroit to Chicago roadway.

He said "In 1911 Milwaukee was without good roads of any kind. The county received $50,000 from the State Highway funds, and before we started this work, we visited a number of places, including Detroit and Wayne County, Michigan. We decided to build cement concrete roads, and that first year we constructed six miles of this type of road. Some mistakes were made that year in the selection of materials, but we have improved our specifications until we are now building a pavement that is first class in every particular. Next year we propose building twenty-five miles of this same type of pavement, thereby completing all of the trunk line roads in our county"

Mr. Jacobus in conclusion told of and explained the county loop that is now being built, connecting all of the roads radiating out of Milwaukee. This loop is fifty-two miles in length, and completely encircles the county. When this loop is completed, he said, every farm in Milwaukee County will be within two miles of a first class concrete roadway.

Prior to adjournment, the following officers were elected: President, Philip T. Colgrove, Hastings, Michigan; Vice President, M. P. Hull, Diamondsdale, Michigan; Secretary, A. A. Anderson, Hastings, Michigan; Treasurer, J. Edward Roe, Lansing.

### THE THURSDAY SESSIONS

The sessions on Thursday were largely composed of technical and progress reports, the latter showing what the leading counties in the State have accomplished in road construction and maintenance.

Hon. Horatio S. Earle, known all over Michigan as "Good Roads Earle," and really the father of good roads in Michigan, as the first highway commissioner, was not on the program, but his friends demanded a talk. Mr. Earle stated that the best law passed by the 1915 Legislature was that which provided for one-half of the automobile tax to revert back to the county which paid it, to be used for road maintenance, the other half being given to the State for the use of the State Highway Department. He also stated that the farmers are often likely to overlook the part played by the cities in supporting good roads, an instance of which was the fact that Detroit had voted six to one for the adoption and construction of a county road system in Wayne County, while that city today pays eighty-five cents out of every dollar for road construction and mainteance in the county.

Mr. Earle stated that when he paid the first reward on the first mile of concrete road in Michigan, a great many people laughed and made fun of his action, but that those same people who ridiculed him are today building the greatest actual yardage of this same type of roads. "I've been vindicated," he declared, "and I am neither an engineer or an expert."

W. J. Cleary, engineer of Berrien County, Michigan, presented an excellent paper on "Bituminous Surfaces." In speaking of oiling roads, he said that oil treatment will not make a bad road good, but that it will, in almost every case, keep a good road good. However, if the oil is not properly applied, it will often make a good road bad.

Mr. Cleary stated that his county has no local materials suitable for road building, so that all materials have to be imported. For a long time they found that water-bound macadam was the best type of road for the county. With the changing and increase of traffic, however, they found that this type of road needed some method of protection, so they have for several years been putting a bituminous surface on all of their roads, this type now being their standard type. The work was first done with a horse-drawn sprinkling cart, but the county has now purchased and uses an auto truck pressure distributor with a heater attached, and finds that this method of treatment is both much more eco-

(*Continued on page* 43)

# Recent Developments in Bituminous Macadam and Bituminous Concrete Pavements

BEFORE proceding with the discussion of the many improvements in the construction of bituminous macadam and bituminous concrete pavements which have been developed during the period from 1914 to 1916, it is advisable, in order to avoid misunderstandings, to quote the definitions of the two types of pavements as recommended by the Special Committee on "Materials for Road Construction" of the American Society of Civil Engineers.

> "Bituminous Macadam Pavement. One having a wearing course of macadam with the interstices filled by penetration methods with a bituminous binder."
>
> "Bituminous Concrete Pavement. One composed of stone, gravel, sand, shell, or slag, or combinations thereof, and bituminous materials, incorporated together by mixing methods."

## GENERAL

Certain developments which are common to both classes of bituminous pavements will be discussed prior to considering improvements which specifically refer to each of the several types.

*Foundations.* There has been a general acknowledgment of the ultimate economy of constructing adequate foundations to support the amount and character of traffic which the several types of bituminous pavements are able to carry. In the case of bituminous macadam pavements, this development usually has been characterized by the construction of well-compacted, and, in many cases, thoroughly filled, broken-stone foundations. In the case of bituminous concrete pavements, due to numerous failures which have occurred where this type of pavement has been built on old macadam or poorly constructed broken-stone foundations, there has been a general tendency to advocate the use of cement-concrete foundations from four to six inches in thickness. It has generally been found that the cost of cement-concrete foundations does not exceed the cost of well-compacted and -filled broken-stone foundations of equivalent strength. Furthermore, the use of cement-concrete foundations renders repairs and renewals more satisfactory and much easier of accomplishment.

*Non-bituminous Highway Materials.* There has been a general recognition since 1914 of the desirability of covering in specifications in more detail and with greater rigidity the physicial properties of the aggregates to be employed and the sizes of the particles which compose such aggregates. For example, the 1914 Specifications of the American Society of Municipal Improvements covering bituminous macadam pavements, state, with reference to the physical properties of the stone, that the rock employed must meet the following requirements:

> "The broken stone shall be subjected to abrasion tests and toughness tests conducted by the engineer in accordance with methods adopted by the American Society for Testing Materials, August 15, 1908. The broken stone used for the construction of the first and second courses shall show a French coefficient of wear of not less than 7.0 and its toughness shall be not less than 6.0. The broken stone used for the construction of the third course and for the first and second applications of No. 1 broken stone shall show a French coefficient of wear of not less than 11.0 and its toughness shall not be less than 13.0."

The necessity for more carefully drawn specifications covering the sizes of the particles of which a given product of a stone crushing and screening plant is composed, is illustrated by the following mechanical analyses of two products obtained from the same plant, both of which products passed over a section of a rotary screen having circular holes of one and one-fourth inches and through a section of a rotary screen having circular holes two and one-fourth inches in diameter.

| | Sample "A" | Sample "B" |
|---|---|---|
| Passing ⅛ inch screen | 0.2% | 0.1% |
| Passing ¼ inch screen | 0.1 | 0.1 |
| Passing ½ inch screen | 0.4 | 1.1 |
| Passing ¾ inch screen | 2.2 | 12.6 |
| Passing 1 inch screen | 8.0 | 37.5 |
| Passing 1¼ inch screen | 29.1 | 40.9 |
| Passing 1½ inch screen | 27.1 | 7.7 |
| Passing 2 inch screen | 32.9 | 0.0 |
| | 100.0% | 100.0% |

It is hence obvious that for many forms of bituminous construction, in order to secure successful results, greater care must be used in the writing of specifications for products of broken stone. As an illustration of an improvement in specifications covering this detail, there is cited those adopted at the 1915 Convention of the American Society of Municipal Improvements, covering broken stone to be used for the aggregate of one type of bituminous concrete pavement:

> "Broken stone for the mineral aggregate of the wearing course shall consist of one product of a stone crushing and screening plant. It shall conform to the following mechanical analysis, using laboratory screens having circular openings: All of the broken stone shall pass a one and one-quarter (1¼) inch screen; not more than ten (10) per cent. nor less than one (1) per cent. shall be retained upon a one (1) inch screen; not more than ten (10) per cent. nor less than three (3) per cent. shall pass a one-quarter (¼) inch screen."

It is noted that in this form of specifications an attempt is made to cover in the mechanical analysis only the limits of the smallest and largest particles. No attempt is made to secure a carefully graded aggregate but simply a product suitable for the type of pavement in question and uniform in character. For example, the following mechanical analyses show three products used in the successful construction of three different bituminous concrete pavements of the type mentioned.

| | Sample "A" | Sample "B" | Sample "C" |
|---|---|---|---|
| Passing ⅛ inch screen | 1.2% | 2.7% | 1.0% |
| Passing ¼ inch screen | 4.2 | 5.6 | 2.5 |
| Passing ½ inch screen | 34.7 | 45.0 | 30.8 |
| Passing ¾ inch screen | 40.6 | 35.1 | 34.2 |
| Passing 1 inch screen | 17.3 | 10.1 | 23.4 |
| Passing 1¼ inch screen | 2.0 | 1.5 | 8.1 |
| | 100.0% | 100.0% | 100.0% |

*Bituminous Materials.* There has recently been considerable discussion pertaining to the advisability of the adoption of so-called "alternate type" specifications in preference to the so-called "blanket" specifications for bituminous materials. By alternate type specifications is meant a series of specifications, each of which covers the physicial and chemical properties of the most desirable grade of a given type of bituminous cement for the purposes for which it is to be used. On the other hand, a blanket specification covers in one set of requirements, pertaining to physical and chemical properties, all the types of bituminous cement which are to be used in connection with the construction of a given kind of pavement. For example, in the case of specifications for asphalt cement for bituminous concrete pavements, it would be desirable under alternate type specifications to have not less than five sets of physical and chemical requirements, the limits for each requirement being as narrow as the several processes of manufacture would permit; while on the other hand, a blanket specification would cover with a wider range of limits the same chemical and physical properties of the five types mentioned. As an illustration will be cited the limits in the cases of Specifications "A" to "E" inclusive under the alternate type specification method for specific gravity, and the penetration at 25° C. (77° F.).

Presented before the Third Canadian and International Good Roads Congress, Montreal, Canada, on March 10, 1916, by Arthur H. Blanchard, M. Am. Soc. C. E., Professor in Charge of the Graduate Course in Highway Engineering, Columbia University, and Consulting Highway Engineer, New York City.

| | "A" | "B" | "C" | "D" | "E" |
|---|---|---|---|---|---|
| Sp. Gr. | 0.97-1.00 | 1.00-1.03 | 1.03-1.04 | 1.025-1.05 | 1.04-1.06 |
| Pen't | 75-90 | 90-100 | 70-90 | 85-95 | 140-160 |

In the case of a blanket specification to cover the same grades of the several types, the limits for specific gravity would have to be 0.97 to 1.06 and the limits for penetration would be 70 to 160. The penetration test, for example, can only be of maximum value when applied to the grade of a specific type of bituminous cement which is most suitable for the type of pavement in question. In the case of the bituminous concrete pavement of the type mentioned, the proper penetration limits for a California asphalt lie between 70 and 90, while for a fluxed Bermudez asphalt to be used in exactly the same type of pavement and under the same conditions, the penetration limits should be between 140 and 160. It is evident that to attempt to cover the penetration limits for both materials in one specification is impracticable. In the first place, such limits as 70 to 160 are so wide as to insure but little uniformity in different lots of the same material; and in the second place, an entirely unsuitable material of one class could be supplied under the maximum or minimum test limits of the other class.

The proper use of alternate type specifications allows the contractor to bid to supply so many tons of bitumen which will comply with any one of the sets of requirements. It will be noted, therefore, that the contractor is in exactly the same position as in the case when he bids to supply any asphalt cement which will comply with the requirements of a blanket specification.

*Guarantees.* There has been a general tendency to abandon the use of guarantees on bituminous pavements, as it is believed that, with proper specifications and efficient supervision and inspection, guarantees are not necessary and that the requirement of a guarantee materially increases the prices bid on a given pavement. The subject of guarantees is too broad to discuss in this paper, but it should be noted that under the title "The Economics of Guarantees of Pavements on State and Municipal Highways," it has been admirably treated by Mr. George C. Warren in a lecture in the graduate course in highway engineering at Columbia University, which lecture has been published under the auspices of the National Highways Association, Mr. Charles Henry Davis, President.

### BITUMINOUS MACADAM PAVEMENTS

In addition to the improvements noted above, the most notable recent development in the construction of bituminous macadam pavements has been in connection with the compaction of the road metal and the distribution of the bituminous materials.

As a result of the numerous failures of bituminous macadam pavements which have occurred due to the improper rolling of wearing courses of road metal prior to the application of bituminous material, there has been a general recognition of the necessity for more thorough compaction of the road metal. This principle has been recognized by the Special Committee on "Materials for Road Construction," of the American Society of Civil Engineers in its 1915 report, the conclusion referred to reading as follows:

> "An important factor for successful results is the proper compaction by rolling of the road metal before the spreading of the bituminous material."

The above committee emphasizes another improvement which is aimed at, the use, in some cases, of an excess amount of bituminous cement in this type of pavement. This conclusion is as follows:

> "Present indications are to the effect that the use of bituminous materials in quantities of more than two and one-half gallons per square yard where the upper course of the macadam is to be three inches in thickness after compaction, is inadvisable under the penetration method."

There has been a general recognition of the advisability of using properly designed distributors in connection with the application of bituminous materials in order to secure uniform distribution economically. Some specifications cover the requirements which a distributor must meet. For example, the 1914 specifications of the American Society of Municipal Improvements contain the following paragraph pertaining to the pressure distributor:

> "The pressure distributor employed shall be so designed and operated as to distribute the bituminous materials specified uniformly under a pressure of not less than twenty (20) pounds nor more than seventy-five (75) pounds per square inch in the amount and between the limits of temperature specified. It shall be supplied with an accurate stationary thermometer in the tank containing the bituminous material and with an accurate pressure gauge so located as to be easily observed by the engineer while walking beside the distributor. It shall be so operated that, at the termination of each run, the bituminous material will be at once shut off. It shall be so designed that the normal width of application shall be not less than six (6) feet and so that it will be possible on either side of the machine to apply widths of not more than two (2) feet. The distributor shall be provided with wheels having tires, each of which shall not be less than eighteen (18) inches in width, the allowed maximum pressure per square inch of tire being dependent upon the following relationship between the aforesaid pressure and the diameter of the wheel: For two (2) foot diameter wheel, two hundred and fifty (250) pounds shall be the maximum pressure per linear inch of width of tire per wheel, an additional pressure of twenty (20) pounds per inch being allowed for each additional three (3) inches in diameter."

This specification provides for a distributor by which it is practicable, under competent supervision, to secure uniform application of the bituminous material and allows the use of a pressure distributor without danger of rutting of the wearing course of broken stone by narrow tires carrying excessive weights.

### BITUMINOUS CONCRETE PAVEMENTS

The improvements in the construction of bituminous concrete pavements to which attention should be called will be considered under the following classification of the three types into which bituminous concrete pavements generally may be divided. These types are designated as follows:

*A.* A bituminous concrete pavement having a mineral aggregate composed of one product of a crushing and screening plant.

*B.* A bituminous concrete pavement having a mineral aggregate composed of a certain number of parts by weight or volume of one product of a crushing and screening plant and a certain number of parts by weight or volume of fine mineral matter such as sand or stone screenings.

*C.* A bituminous concrete pavement having a predetermined mechanically graded aggregate of broken stone or gravel, either alone or combined with fine mineral matter, such as sand or broken stone screenings.

*Patents.* Unfortunately, the present status of patent litigation has to be considered in connection with the discussion of the several types of bituminous concrete pavements. The majority of engineers and highway officials are interested in the types of bituminous concrete pavements which may be constructed without danger of litigation rather than in a prolonged discussion of the probabilities of successfully defending suits for infringement. There is ample evidence at hand that bituminous concrete pavements of type *A* may be constructed without danger of litigation proceedings provided that the mineral aggregate is of the general character heretofore mentioned in this paper under the section, "General. Non-bituminous Highway Material."

The history of litigation cases indicates that the construction of bituminous concrete pavements of type *B* on a large scale will in all probability lead to litigation. The same remarks apply to the construction of bituminous concrete pavements of type *C* except in the case of the so-called Topeka bituminous concrete pavement with an aggregate of the type specified either in the 1910 Topeka decree or of the grading which was adopted at the 1915 convention of the American Society of Municipal Improvements.

*Type A. Materials.* Practice has demonstrated that broken stone, because of the satisfactory mechanical bond secured, makes the most suitable aggregate for this class of bituminous concrete, although pavements constructed with gravel have proved satisfactory for light traffic where great care has been taken in the selection of the gravel and in the construction of the pavement. The development of the character of materials used in current practice has been covered in this paper under the title "General." Much more care has been taken in recent years with reference to the quantity of bituminous cement to be used in the mix. There has been a general recognition that the amount used depends upon the kind of road metal and the bituminous material, the character of the aggregate, and the climatic conditions. For the product of broken stone heretofore mentioned, it has been found that bituminous concrete mixtures should contain between 5 and 8 per cent. by weight of bitumen.

*Mixing.* Many improvements are noted in the methods employed in the mixing of bituminous concrete. There has been a general evolution from hand mixing methods to the utilization of mechanical mixers especially designed for the manufacture of this type of bituminous concrete. The large contract for thirty-five miles of bituminous concrete pavement of this type around the Ashokan Reservoir, constructed under the direction of the Board of Water Supply of the city of New York, demonstrated the desirability of the manufacture of a plant especially designed for this class of work. The type finally evolved showed that it is practicable and economical to use a self-propelled plant, consisting of elevators, a rotary dryer, weighing devices, and a mixer, having a capacity of from 800 to 1,000 square yards of two-inch wearing course per day. Experience has demonstrated that, except on small contracts and for repair work, mixers which provide for the heating of broken stone by the use of a flame in the chamber, should not be used on account of the danger of burning the broken stone or the bituminous concrete.

*Laying.* There has been considerable discussion pertaining to the proper type and weight of roller to be used for the compaction of the wearing course. Experience demonstrates that in order to secure an even surface and adequate compaction by thorough interlocking of the particles of broken stone, a tandem roller weighing between ten and twelve tons should be used.

*Seal Coat.* Many methods have been developed for the application of the seal coat of bituminous material. It has been found that seal coats of from one-half to one gallon per square yard of bituminous cement are distributed most uniformly by the use of hand-drawn gravity distributors followed by a squeegee.

*Seasonal Limitations.* Experience in many localities has demonstrated that bituminous concrete of this type should not be mixed or laid when the air temperature in the shade is below 50° F., as otherwise it is difficult, under average conditions, to secure an even and well-compacted wearing course.

*Type B.* Specifications for this type of pavement have, during recent years, generally stipulated that so many parts of broken stone and so many parts of sand or other fine material are to be mixed with a certain amount of bituminous cement. By the use of this specification, unless employed under unusual supervision, it has been found to be impracticable to secure a well-graded aggregate. In many cases, the mixture has contained an excess of broken stone with insufficient fine material to fill the voids therein, while in other cases it has contained an excess of sand in which the broken stone exists as isolated particles. It is the conclusion of many engineers, because of the conditions described, that when bituminous concrete pavements are to be employed, either type *A* or type *C* should be selected.

*Type C.* During recent years, the bituminous concrete pavements of this type which have been most extensively employed are known as Bitulithic, Warrenite, and Topeka.

*Bitulithic and Warrenite. Differentiation.* The general use of Bitulithic and Warrenite bituminous concrete pavements throughout America has brought up for discussion the matter of the fundamental differences between these two types of patented pavements. It is believed that it will be of interest and value to the engineering profession to submit the following statement, prepared by Mr. George C. Warren, President, the Warren Brothers Company, for the information of the engineers enrolled in the graduate course in highway engineering at Columbia University:

> "Bitulithic and Warrenite mixtures are both made under the provisions of the Warren patents, which the courts have held 'cover the product no matter how produced.' Bitulithic is designed to meet the conditions generally prevailing on city streets, and Warrenite is to meet such conditions as may arise on country roads so as to meet the physical and economic conditions and public demands as to cost.
>
> "Generally speaking, Bitulithic is mixed by a plant which is too cumbersome to meet country road conditions, which provides for combining the materials proportioned by separation of sizes of the aggregate, after heating, and then recombining by weight.
>
> "Warrenite is, generally speaking, mixed by a plant so portable that it may be set up either alongside the railroad, along the side of the road being constructed, or in the quarry or gravel bank from which the bulk of the aggregate is being procured, as may be most economical in any particular case. This plant is constructed on the principle of proportioning the several separated sizes by careful measurement by bulk before heating and retaining the batch so measured as a separate entity through the process of heating and delivery into the mixer in which the bituminous cement is added.
>
> "Generally speaking, crushed stone predominates in the fine aggregate of Bitulithic, while sand predominates in the fine aggregate of Warrenite; also, fine crushed stone and sand respectively are correspondingly used for the seal coat aggregate.
>
> "In the selection of quality of material (whether gravel or crushed stone) for the coarse aggregate, a greater latitude is permitted in the case of Warrenite to practically meet the conditions of less opportunity for selections which are liable to prevail in localities considerable distance from railroad centers. This latitude is allowed, because, while the traffic conditions on country road thoroughfares are in point of weight and concentration of traffic rapidly becoming fully as severe as on most city streets, there is the important difference that on country roads generally the traffic is more exclusively of the motor-vehicle rubber-tire type and consequently less exaction in physical properties of the quality of the stone forming the basis of the aggregate is necessary. Also, unfortunately, many city streets are abused by constant excessive sprinkling or daily scoured by pressure flushing machines, a practice which is more or less injurious to any road surface, while country roads are seldom, if ever, wet except by rainfall; therefore, in cases where the very best quality of stone is unavailable, it would be safe to use stone of slightly lower quality in Warrenite on a country road although the same quality stone might not be safe for use in Bitulithic on a city street."

*Topeka.* In many specifications the mineral aggregate for the Topeka pavement specified has been that contained in the decree of 1910, namely:

> "Bitumen, from 7 per cent. to 11 per cent.
>
> "Mineral aggregate, passing 200-mesh screen, from 5 per cent. to 11 per cent.
>
> "Mineral aggregate, passing 40-mesh screen, from 18 per cent. to 30 per cent.
>
> "Mineral aggregate, passing 10-mesh screen, from 25 per cent. to 55 per cent.
>
> "Mineral aggregate, passing 4-mesh screen, from 8 per cent. to 22 per cent.
>
> "Mineral aggregate, passing 2-mesh screen, less than 10 per cent."

Many unsatisfactory pavements have resulted by the unintelligent use of this grading. It has been found necessary, in order to secure successful results, to specifically define the character of the sand or other fine material which shall be employed in order to secure a satisfactory grading. Many

specifications now cover the sand grading with almost the same care as in the case of sand grading requirements for sheet asphalt pavements. In order to encourage the use of a more satisfactory grading for this type of pavement, the American Society of Municipal Improvements in 1915 recommended the adoption of the following grading:

"Passing 200-mesh screen, 7 to 10 per cent.

"Passing an 80-mesh screen but retained on a 200-mesh screen, 10 to 20 per cent.

"Passing a 40-mesh screen but retained on an 80-mesh screen, 10 to 25 per cent.

"Passing a 20-mesh screen but retained on a 40-mesh screen, 10 to 25 per cent.

"Passing an 8-mesh screen but retained on a 20-mesh screen, 10 to 20 per cent.

"Passing a 4-mesh screen but retained on an 8-mesh screen, 15 to 20 per cent.

"Passing a 2-mesh screen but retained on a 4-mesh screen, 5 to 10 per cent."

* * *

## Strong Comparative Cost Data on Sterling Motor versus Horse Dump Trucks

EVERY road contractor who has 5,000 yards of loose material to haul can handle this minimum amount of material more profitably in a heavy duty dump truck. The following analysis shows comparative yardage moving capacity and the equivalent cost of the motor and the animal drawn handling system, the actual saving in money and the greater tonnage delivery capacity of the motor truck method.

This analysis has been verified from the actual experience of road contractors in the States of Ohio, Indiana, and West Virginia, and is in no wise a theoretical display of mathematical gymnastics to confound and convict the horse dump truck system of handling road-building materials.

### OPERATING COST OF TEN TEAMS CONSIDERED AS THE HAULAGE EQUIVALENT OF ONE FIVE OR SEVEN TON STERLING DUMPER

Consider ten teams complete with wagons and harness as representing the equivalent investment of one seven ton Sterling dumper, namely, $5,000. Take the case of a contractor having three and one-half miles of water-bound macadam road to build—a road sixteen feet wide nine inches deep. This requires the haulage of 8,213 cubic yards of crushed stone. Thus the average length of haul for building this road is two miles. Consider teams as owned and teams as hired, $4 per day per team. If the contractor owns his teams, his cost per day for operating them will be made up of the following items:

| | |
|---|---|
| Ten drivers | $15.00 |
| Feed | 10.00 |
| Shoeing | 2.50 |
| Interest on investment | 1.00 |
| Natural depreciation | 3.50 |
| Repairs | 2.00 |
| Total per diem cost of ten teams | $34.00 |

The teams average five trips each per day, hauling an average of two yards of material per trip. Total haulage per day per team ten yards; for ten teams 100 yards. Dividing 100 yards into $34 gives a cost of thirty-four cents per yard. If the teams are hired, the aggregate rental cost would be $40 per day or forty cents per yard.

### OPERATING COST OF STERLING HEAVY DUTY DUMPER

Considering the cost of hauling with a Sterling dumper we find this to be an average of $17 per day made up of the following items:

| | |
|---|---|
| Interest on investment | $1.00 |
| Natural depreciation | 3.50 |
| Driver | 3.00 |
| Gasoline | 3.00 |
| Oil | .50 |
| Repairs | 2.00 |
| Tire wear | 4.00 |
| Total per diem operating cost on fifty mile per day schedule | $17.00 |

For the same two mile haul carrying five yards per load, the Sterling dumper will make two round trips per hour hauling 100 yards in ten hours at a cost of seventeen cents per yard or just half the cost for the same amount of material handled with teams owned and approximately sixty per cent. less than the cost with rented teams. On a three and one-half mile contract a contractor would save on handling 8,213 yards with a Sterling dumper the sum of $1,396 (8,213x$17=$1,396) on the basis of owning his teams. And by using a Sterling dumper he would save $1,889 (8,213x$23=$1,889) on the basis of hiring his teams.

The Sterling dumper would thus save over the teams that are owned by the contractor the sum of $17 per day and over the hired teams $23 per day. Figuring that both systems will handle 100 yards per day as an average, it will take approximately eighty-two days to deliver this material if there were no lost time, which is not usually the case. One can conservatively estimate eighteen days of lost time which would require 100 days to complete the job. These eighteen days would be an inactive period but it would be necessary in either case, using a motor truck or horse teams, for the contractor to keep his organization together. Whether working or idling, the maintenance cost of the teams is the same. Consequently eighteen days of idling with team haulage costs the contractor in maintenance alone $612 (eighteen days at $34 per day).

Comparing the maintenance cost of the Sterling dumper for 18 days of idleness with the maintenance expense of horse haulage:

The only maintenance cost of the truck when idle would be the interest of the investment and the cost of the driver, amounting to $4 per day or $72 for the eighteen days—a difference of $540 actual saving in favor of the truck from eighteen days of enforced idleness. Adding this figured amount of $612 to the expense to the contractor of doing his haulage with owned teams, the total amount lost is $1,936 ($1,396 plus $540=$1,936).

### COMPARISON OF SAVING IN TIME AND HENCE MONEY OF A STERLING DUMPER OVER HORSE TEAMS

The above conservative figures are based upon a contractor requiring 100 days to complete the contract. Even if he owns his teams he cannot haul the amount of material demanded in less than eighty-two days. If he owns the Sterling dumper he can do the same work in one-half the time due to the fact that he can work nights to a greater advantage with the Sterling dumper than he can during daylight hours *because traffic is off the highways at night and a Sterling dumper can be run at a higher average speed.* Hence he can very likely save a portion of the eighteen days we have estimated as lost. Contractors have advised us that with a Sterling dumper they have been able to make up from ten to twenty per cent. of enforced idleness due to the advantage of operating a Sterling at night.

### COMPARISON OF MAINTAINING A STERLING DUMPER AND HORSE TEAMS DURING 100 DAYS OF INACTIVITY

We can conservatively figure on 100 days of inactivity of the contractor during the winter months. Consider the cost of taking care of ten teams during the winter months—and the contractor certainly must do this because he cannot sell off his horses at a loss when the demand is slack and buy them again in the spring when the demand is active on a rising market. The winter cost of keeping horse teams amounts to an average of $16.25 per day made up of

| | |
|---|---|
| Interest on investment | $ 1.00 |
| Daily cost of feeding | 10.00 |
| Two hostlers | 3.00 |
| Shoeing | 1.25 |
| Stabling | 1.00 |
| Total up-keep per day for ten teams | $16.25 |

### COST OF MAINTAINING A STERLING DUMPER THE WINTER

| | |
|---|---|
| Interest on investment | $1.00 per day |
| Garage storage | .50 per day |
| | $1.50 |
| Total cost of maintaining ten teams 100 days | $1,625.00 |
| Total cost of maintaining Sterling dumper 100 days | 150.00 |
| Total saving in maintenance of Sterling dumper | $1,475.00 |

Horse teams therefore during the actual idle period of 100 days consume $1,475 which is approximately twenty-five per cent. of their investment outlay, figuring this at $5,000. Assuming the useful life of the teams to be four years, the total loss a contractor incurs from his horse haulage system amounts to 4x$1,475=$5,900 for merely maintaining them during the winter months. In other words, he pays the investment outlay twice as an essential insurance for keeping together his physical organization.

The bigger the contractor's operations—and necessarily the bigger amount of his horse equipment—the bigger the proportionate loss. For example: Suppose the same contractor has two three and one-half mile road jobs and operates twenty teams on this basis, the loss by owning the teams on the two contracts would be twice $1,936 or $3,872. But this is not all. The contractor has an additional loss of 100 days during the winter months for the other ten team units or $2,650.

* * *

## Maryland

### Work of the Maryland State Roads Commission During the Past Two Years

MARYLAND has been most active in her work of constructing her State system of highways during the past five or six years, and today has what is probably one of the best and most complete systems of improved highways possessed by any State in the United States. The main system has been nearly completed, and the greater part of the work remaining is the construction of small gaps in the main system and in the construction of laterals, although the latter were not included in the system as originally laid out. The greater part of this work will be completed during the present year, so that Maryland will be able to announce that she possesses an actually completed State Highway system of considerably more than a thousand miles.

The work of 1914 and 1915 is very closely related, so that this account of what has been accomplished will deal with these two years only, previous years having already been described in a series of articles published in Better Roads and Streets last summer. The two years, however, will be kept entirely separate, and in the July issue of Better Roads and Streets will be presented a detailed article dealing with the wonderful system of maintenance in force in Maryland, and the results that have been accomplished.

#### SUMMARY OF 1914 OPERATIONS

In order to secure for the State the benefit of low bids and sharp competition from contractors who were unemployed during the winter of 1914, it was anticipated that the Legislature would make another large appropriation as recommended by the State Roads Commission, and with this end in view, advertisements for bids for the construction work to be done in 1914 and 1915 were made in advance, and contracts let, subject to sufficient money being provided by the Legislature to cover them. All contracts, after being advertised and bids opened, were let to the lowest responsible bidders, under bond of a satisfactory surety company. These advertisement were so planned that four or five contracts, aggregating from ten to twenty miles of road, were advertised each week, this continuing for a period of about twenty weeks. This gave the bidders who were not successful at one letting an opportunity to bid again the following week, and so on until each could have had a chance to obtain his quota of the work. Bids were opened in this way continuously through February, through March and April, and through a portion of May, by which time the necessary amount of work had been let. By this procedure each contractor was given an opportunity to bid until he was successful in securing contracts. This also gave the advantage of having a number of contractors building different sections, rather than one contractor having several pieces of work to do. Some of the contracts were advertised for long sections, which induced many wealthy contractors with large outfits, including steam shovels, etc., to come into the State from New York, New Jersey, Pennsylvania, Virginia, Massachusetts, and other States. As a result of this method, many of the bids were exceedingly low, and the State is estimated to have saved between $250,000 and $500,000 over what this work would have cost if it had not been advertised until after the appropriation bill was signed on April 16, as was the case in 1912.

In anticipation of this large volume of construction, in March the field forces were enlarged, and the number of residencies in the State was increased from eight to eleven. This gave less territory to the resident engineers, one of whom is in charge of each of the residencies, and each of whom was located centrally in his residency, and who was placed in charge of all the construction, as well as all the maintenance, and other work. By thus dividing the State up into smaller units, each resident engineer was able to handle to better advantage the larger amount of work in his division.

After thorough study, the contracts and specifications were modified and simplified, so as to expedite actual construction and to bring it up to the latest methods.

It had formerly been the practice to have the monthly estimates come in at the end of each month, thus throwing a very large amount of work on the office force at the beginning of the succeeding month. This difficulty was met by having one-third of the Resident Engineers take their estimates between the first and tenth of the month, one-third between the tenth and the twentieth, and the remaining one-third between the twentieth and the thirtieth. This made a continuous flow of estimates coming into the office from the field, and enabled a minimum number of employees to handle a maximum amount of work. By this arrangement the much larger number of estimates was handled expeditiously, economically, and more satisfactorily.

On April 16, 1914, the Legislature made an additional appropriation of $6,000,000, of which $5,000,000 was to be applied in filling in the main gaps of the system in the counties, and $1,600,000 for Baltimore City to build the Light (Hanover) street bridge and for paving streets.

The law provided that the $5,000,000 appropriated for the counties should be expended in paying for the work already done in counties in excess of previous allotments, in finishing the work then under construction and not completed, and should be applied, first, to filling in the main gaps of the system, and that the balance remaining thereafter should be used for secondary gaps, for necessary bridges, for rights of way, for overhead expenses, for the construction and maintenance of the Washington Boulevard ($50,000.00), and for other miscellaneous purposes.

It also specifies that so much of the $1,600,000 as might be necessary, should be used by the State Roads Commission in constructing a new bridge over the Patapsco River from Baltimore city to Brooklyn, in Anne Arundel County, and that upon the completion of the said new bridge, the Mayor and City Council of Baltimore should remove the Light street bridge, and that any balance remaining after the cost of constructing the new bridge had been defrayed should be used by the State Roads Commission for the paving of streets in Baltimore city.

In 1914, the legislature also passed an act changing the personnel of the Maryland State Roads Commission, so that there should be two paid members on the Board in place of the two unpaid members from the Maryland Geological and Economic Survey, and providing further that two members of the Commission should be of different political faith from that of the governor of the State. In pursuance of this law, on May 29, Governor Goldsborough appointed Thomas Parran, Republican, of St. Leonard, Calvert County; J. Frank Smith, Democrat, of Scotland, St. Mary's County, and John M. Perry, Democrat, of Centreville, Queen Anne County, as members of the Commission to fill the places held by the members of the Maryland Geological and Economic Survey, and a vacancy caused by the death during the year of one of the members of the Commission.

By the end of June approximately $2,335,000 of contracts had been let, covering 230 miles of road, and advertising for bids was discontinued, except in special cases, and where plans were delayed because of rights of way, or from other causes. Experience demonstrated that the organization perfected by the Commission was sufficient to have handled a much larger quantity of work, if the funds had been available for the purpose. As it was, it was let and carried out smoothly and economically, and by the end of the year a large percentage

of the new mileage was opened to traffic, and the balance was in good condition to pass through the winter.

On the State system, 285 miles of new road were begun at a cost of $3,089,000; 225 miles were completed; 204 miles were under construction at the end of the year; surveys were made of 534 miles, and plans were prepared for 443 miles.

In the maintenance department, 448 miles of road were oiled; 851 miles of road were maintained, and a total of $309,503.98 was spent for oiling and mainteance.

On State aid work, sixty-nine miles of new road were started at a cost of $624,279, and twenty-one miles were certified to the State Comptroller. Surveys were made of 102 miles and plans were prepared for seventy-six miles, while twenty-one miles were accepted and turned over to the counties.

The total expenditures for the year on the 354 miles of State and State aid work amounted to $3,713,279.00.

### SUMMARY OF 1915 OPERATIONS

By virtue of the large amount of work finished in 1914, it became possible to reduce the working forces in 1915, and in February the Engineering Department was re-organized, and the number of residencies in the State was reduced from eleven to eight. During the same month a combined gang and patrol system of maintenance was introduced and put into operation in several counties. Contracts for the balance of the uncompleted work were let as rapidly as possible, and a larger percentage of a more durable type of construction was called for than in previous years, because of the heavy increase in motor traffic of all kinds. By early summer all the contracts carried over from 1914 were completed, as well as substantially all the work let in 1915, and by the end of 1915, the work provided for by the legislature was practically finished with the exception of several sections in the city of Baltimore, one or two sections in the counties, and the Hanover street bridge.

By November 15, 1915, the main system was about completed, and it was possible to ride over trunk lines as follows:

A. From Oakland, in Garrett County, at the western end of the State, through Cumberland, Hagerstown, Frederick, Baltimore, Elkton, Chestertown, Centreville, Easton or Denton, 350 miles to Cambridge, or 405 miles through Salisbury to Ocean City, on the Atlantic ocean, or 406 miles through Princess Anne to Crisfield at the southern extremity of the Eastern shore.

B. From Baltimore 127 miles to Point Lookout in Southern Maryland, via Washington, Waldorf, Bryantown, Hughesville, Charlotte Hall, Leonardown, and St. Mary's.

C. From Baltimore City eighty-four miles to Solomon's Island, the southernmost point in Calvert County, through Annapolis, Birdsville, Mt. Zion, Owing's Station, Prince Frederick, and Lusbys.

D. Over about three hundred miles of the system not directly included in the foregoing arteries. This makes approximately a thousand miles of the system completed at the end of 1915.

On the State system, 202 miles of new road were started at a cost of $2,650,000; 187 miles of road were completed and fifteen miles were under construction at the end of the year. Surveys were made of 368 miles and plans were prepared for fifty-three miles.

In the Maintenance Department, 504 miles of road were oiled, and a total of $379,028.20 was spent for oiling and maintenance.

On State aid work, seventy-three miles of new road were started, the cost of which was $592,375, and fifty-five miles were certified to the State Comptroller. Surveys were made of 238 miles and plans were prepared for 150 miles. Fifty-five miles were accepted and turned over to the counties.

The total of 275 miles of State and State aid road work constructed in 1915 cost approximately $3,242,375.

### MONEY APPROPRIATED AND RECEIVED TO DECEMBER 31, 1915

The last four General Assemblies of the State of Maryland have authorized road bonds for the State work in the sum of $15,770,000, which issues have been disposed of by public sale as provided by the Acts as follows:

| Year | Amount of Bonds | Rate | Net Proceeds |
|---|---|---|---|
| 1908 | $5,000,000.00 | 3½% | $4,760,209.76 |
| 1910 | 1,000,000.00 | 4% | 991,447.55 |
| 1912 | 3,170,000.00 | 4% | 3,110,432.61 |
| 1914 | 6,600,000.00 | 4% | 6,514,434.15 |
| Totals | $15,770,000.00 | | $15,376,524.07 |

Attention is called to the fact that these bonds have been sold at a loss or discount to the State of $393,475.93, and that the average rate received for the $15,770,000 of bonds was 97.5049 per cent.

In connection with the foregoing, it is interesting to note that the Act of 1914, appropriating the $6,600,000, provided that $3,000,000 of these bonds could not be disposed of earlier than August 1, 1914, and the remaining $3,600,000 could not be disposed of earlier than February 1, 1915. In order to promptly meet the payments coming due on the $2,500,000 of contracts that were let early in 1914, advertisement of the sale of the $3,000,000 of bonds was begun on July 6, 1914, with payment to be made on them at the earliest possible date, that is, on August 1. These bids were opened on July 16, and exceedingly low tenders were received, the lowest being $2,977,740, or at the rate of 99.258 per cent. This offer was accepted, but on the day of payment, August 1, the great European war had started, and considerable pressure was necessary to secure full cash payment for the bonds, against which securities had been required as collateral. Had the issue not been advertised until August 1, the bonds could not have been sold for many months, which would have stopped all road building and caused the State a very large loss. The Commission was equally fortunate in selling the remaining $3,600,000 of bonds, advertisement of which was commenced on January 5, 1915, to be paid for at the earliest date, that is, February 1, following. A period of great financial stringency had existed from the opening of the war until just about this date, when money became much easier, and this was the first large issue of bonds in this country to be sold under favorable conditions. A price of $3,539,160 was bid for them, this averaging 98.31 per cent., which offer was accepted, and the money received on February 10. It thus happened that these two issues were sold to the best possible advantage. The net amount for the $6,600,000 was $6,514,434.15, this being an average of 98.7035 per cent. for the whole issue.

In addition to the above, the following issues of State road bonds have been authorized, duly sold and the proceeds applied as provided by law:

A. $100,000 by the Acts of 1910 for improving the Baltimore-Washington boulevard.

B. $20,000 by the Acts of 1910 for the improvement of Columbia Avenue in Baltimore city, from Gwynn's Falls to the entrance to Carroll Park. The cost of this work was $10,000, and the remaining $10,000 reverted to the city of Baltimore as provided by the Act.

C. $80,000 in the Consolidated State Loan of 1913, Acts of 1912, for the improvement of the old Government Post Road in Cecil County.

D. $15,000 from the State treasury by the Acts of 1914 to concrete the Baltimore and Washington road through the village of Elkridge, in Howard County.

### NET AMOUNT AVAILABLE FOR ROAD CONSTRUCTION

The average cost of State roads is frequently obtained by dividing the total face value of the bonds issued by the mileage of completed roads, which method gives a very high cost per mile. This result is so inaccurate and misleading that an analysis has been made by the Maryland Commission, showing the distribution of the proceeds of the $15,770,000 of bonds already appropriated, which shows that many large items must be deducted before reaching the net amount that is available for the actual construction of the mileage of the main arterial system outside of Baltimore city. Some of these principal items which must be deducted as not available for construction, and which will be interesting to note are as follows:

1. Baltimore City, for paving streets and for the Hanover street bridge, $3,145,516.92.

2. Amount paid the United Railways & Electric Company for reconstructing its road and overhead structures, for steel rail for its tracks, and for paving between its tracks and two feet outside, from 1910 to 1915, $343,977.72.

3. Amount paid from 1910 to 1915, inclusive, for the purchase of toll roads and turnpikes, $320,767.50.

4. Cost of the College Creek bridge to date, $51,248.72.

5. Cost of paving streets in South Baltimore to date, $32,542.17.

6. Loss on the sale of $15,770,000 of State road bonds, $393,475.93.

7. Approximated excess of maintenance expenditures of $1,228,511.20 over receipts of $776,918.42, from 1908 to 1915, inclusive, $451,592.78.

8. Purchase of the Conowingo bridge in 1911, under the Public Highways Act of 1910, $88,000.

9. Cost of the Sharptown bridge, with approaches, etc., under the Public Highways Act of 1910, $72,539.54.

10. Estimated cost of the miscellaneous bridges not fairly chargeable against the mileage construction proper, 1909 to 1915, $210,000.

11. For the purchase of steam rollers, sprinklers, traction engines and cars, stone crushers, tools, and other road-building equipment from 1908 to 1910, inclusive, $84,082.27.

12. For preliminary surveys, plans, and estimates for the entire road system from 1908 to 1915, inclusive, $139,940.58.

13. General overhead and administrative expenses, including the salaries of the Commission, engineering, and office force, headquarters' expense, etc., for eight years, 1908 to 1915, this being 3.03075 per cent. on the $15,376,524.07 received from the sale of the $15,770,000 of bonds, $481,400.53.

14. Estimated for various miscellaneous expenditures, supplies, office fixtures, engraving bonds, damages for accidents, for eight years, 1908 to 1915, $131,000.

15. Cash on hand December 31, 1915, $714,868.31.

Total amount not available for the main system, $6,660,952.97.

Leaving total amount available for the main system, $9,109,047.03.

Total amount of the bond appropriation, $15,770,000.

### MILES OF ROAD COMPLETED AND UNDER MAINTENANCE

The following table shows the number of miles of road completed and under maintenance in the State system up to and including December 31, 1915.

| | |
|---|---|
| Main system proper outside of Baltimore city | 862.57 miles |
| Baltimore-Washington boulevard | 30.13 miles |
| Baltimore-Annapolis boulevard | 20.79 miles |
| Streets and bridges in Baltimore city | 16.21 miles |
| Through incorporated town, | 11.93 miles |
| State aid roads taken over in the State system | 49.27 miles |
| Completed lengths of large bridges of Baltimore city | 0.40 miles |
| Miscellaneous | 3.75 miles |
| Total | 995.05 miles |

In addition to the 995.05 miles shown in the above table, there are also included in the State system 53.25 miles of turnpikes that have been purchased, paid for, and are under maintenance, but which have not yet been reconstructed, and 129.92 miles of roads that have been modernized or reconstructed for various reasons, making the total of 1,178.22 miles of road in the State Road System that have been bought, reconstructed and built up to the last day of December, 1915.

### MILES OF ROAD FINISHED BY YEARS

The following table shows the miles of road and the percentage finished by years, including the Baltimore-Washington Boulevard, the Baltimore-Annapolis Boulevard, the State Road System, and roads through incorporated towns, but not including roads built under the State Aid Law, State aid roads taken over in the State system, completed lengths of large bridges, turnpikes not yet reconstructed and duplicated mileage:

| Year | Miles Finished | Percentage Finished Each Year |
|---|---|---|
| 1908 | | |
| 1909 | | |
| 1910 | 45.96 | 5.06 |
| 1911 | 87.51 | 9.62 |
| 1912 | 153.92 | 16.93 |
| 1913 | 202.54 | 22.27 |
| 1914 | 226.41 | 24.90 |
| 1915 | 192.99 | 21.22 |
| Totals | 909.33 | 100.00 |

Of the 153.92 miles finished in 1912, there were 16.03 miles graded in 1910 and 1911, and of the 202.54 miles finished in 1913, there were 14.22 miles graded in 1910 and 1911.

A much larger mileage could have been built in 1913 and in 1915 in nearly every county in the State but for the exhaustion of funds in those years.

### COST OF ROADS IN MARYLAND

With many new and unsolved problems of organization, construction, and maintenance, and with sixteen millions of dollars worth of various kinds of work scattered over twenty-three counties and in the city of Baltimore, administrative capacity and engineering experience of the highest order is required to secure the best results at the least cost in building such a system as ours in so short a period. The results cannot be gauged by tables showing the comparative costs of roads in different States or in different part of the same State, because of widely varying conditions. To accomplish the desired end, it is absolutely essential to have an honest, progressive, efficient, and up-to-date business management, free of politics. A close study must also be made of the ton-miles of traffic that each section of road will have to carry, and careful consideration given to the availability of satisfactory road material for carrying such traffic, as well as to the selection of the types of roads needed in each locality.

In considering the relative cost of our roads by years, it should be borne in mind that there has been an increase of perhaps twenty per cent. to forty per cent. in the cost of stone, labor, freight, and other material used in road building since our system was started in 1908, and as an offset to this, economics have been effected largely through handling this great enterprise on strict business principles; by discrimination in selecting the types and the method of construction used on the roads of Maryland; by the marked increase in the morals, loyalty, and efficiency of the organization; by close supervision of the work in the field by the Chairman, the Assistant Chairman, and the Chief Engineer; by the decrease per mile in overhead expenses; by shortening roads by relocations; by eliminating curves; by discrimination in grading where possible; by saving on the design and unnecessary thickness of concrete and masonry work; by the substitution of corrugated iron culverts for concrete; by securing lower bids, better work and more friendly co-operation from contractors; by procuring rights of way promptly and thereby saving damages claimed by contractors for delays; by the co-ordination of the executive and the engineering forces; by buying supplies through a Purchasing Department; by a modern system of bookkeeping and checking estimates, and by discounting bills, etc.

In 1913, a comparatively large mileage of old turnpikes was resurfaced, in which the old stone bed was utilized for the first course, and a new macadam surface for the second and third courses only. This greatly reduced the average cost per mile for that year, and at the same time gave a road that was just as substantial and durable as the standard macadam, and which compares very favorably with the latter in appearance.

In 1914 and in 1915, a greater proportion of concrete and bituminous was laid, because of the heavy increase in motor traffic of all kinds. An unusual amount of very heavy grading was also done, much of it on relocations, to save distance and to improve the alignment. This accounts for the higher average cost per mile during these two years, the increased cost being a good investment for the State, because of the large saving in future maintenance over the cheaper types of roads.

The table which follows shows the total and the average cost of the roads constructed by the State Roads Commission of Maryland by years. The cost in each case includes preliminary surveys and plans, grading, surfacing, bridges and culverts, underdrains, inspection, and superintendence and rights of way, besides overhead and miscellaneous expenses of every character. The mileage for 1912 includes 16.03 miles and that for 1913, 9.75 miles, making 25.78 miles, which were graded in 1910 and 1911, and were finished (surfaced) in 1912 and 1913, the cost of both grading and surfacing being included in the

1912 and 1913 totals. The mileage given is of the main system proper, not inclusive of Baltimore city or of the specially constructed Washington and Annapolis Boulevards, excepting one contract in Baltimore city of 0.7 mile, costing $49.884.69, which was finished in 1911.

TABLE SHOWING THE APPARENT COST OF ROADS BY YEARS

| Year | Miles Constructed | Total Cost | Average Cost Per Mile |
|---|---|---|---|
| 1908 | | | |
| 1909 | | | |
| 1910 | 45.96 | $ 481,715.68 | $10,481.19 |
| 1911 | 80.69 | 992,199.68 | 12,296.43 |
| 1912 | 138.23 | 1,497,558.85 | 10,833.82 |
| 1913 | 191.79 | 1,589,253.01 | 8,286.45 |
| 1914 | 226.85 | 2,835,458.67 | 12,499.27 |
| 1915 | 190.98 | 2,420,884.29 | 12,676.11 |
| Totals | 874.50 | $9,817,069.76 | $11,225.92 |

In the foregoing table the cost figures by years are apparent and not real, because many of the roads were practically finished and opened to traffic at the end of each working season in the autumn, and were so considered when the books were closed at the end of the calendar year. For this reason the mileage was included in that year, but the roads were not actually accepted from the contractors and paid for until the succeeding calendar year. Hence the final payments on them, including the ten per cent. held back, extras, etc., are necessarily charged in the later year, although the road mileage was included in the previous year.

In order to make this clear, a second table has been prepared which shows the actual cost by years, where all expenditures have been charged in the same year in which the contracts were practically completed. This table is as follows:

TABLE SHOWING THE ACTUAL COST OF ROADS BY YEARS

| Year | Miles Constructed | Total Cost | Average Cost Per Mile |
|---|---|---|---|
| 1908 | | | |
| 1909 | | | |
| 1910 | 49.96 | $ 533,851.87 | $10,685.58 |
| 1911 | 81.68 | 1,022,592.68 | 12,519.50 |
| 1912 | 138.99 | 1,505,941.49 | 10,834.89 |
| 1913 | 186.04 | 1,717,902.19 | 9,234.05 |
| 1914 | 226.85 | 2,889,340.65 | 12,736.79 |
| 1915 | 190.98 | 2,147,440.88 | 11,244.32 |
| Totals | 874.50 | $9,817,069.76 | $11,225.92 |

It will be noted that the totals are the same in both of the foregoing tables, the only variance being in the yearly amounts and averages.

It should also be explained that in the years 1914 and 1915 the contracts included the first oiling of the roads, thereby increasing their cost by that amount, this having been previously charged to maintenance. The cost of the roads for these two years was also largely augumented by the fact that a much larger mileage than theretofore of concrete, bituminous concrete, and other high type construction was built during this period.

The cost of the roads constructed by four years period was as follows:

COST OF ROADS BY FOUR-YEAR PERIODS

| Years | Miles Constructed | Percentage | Total Cost | Average Cost Per Mile |
|---|---|---|---|---|
| 1908-1911 | 131.64 | 15% | $1,566,444.55 | $11,823.49 |
| 1912-1915 | 742.86 | 85% | 8,260,625.21 | 11,120.03 |
| Totals | 874.50 | 100% | $9,817,069.76 | $11,225.92 |

OVERHEAD EXPENSES BY YEARS

The overhead expenses, the mileage and cost of roads constructed, the average overhead expenses per mile and the percentage of overhead expenses to the total expenditures are shown in the following table, which includes Baltimore city and State roads, but which does not include the Baltimore-Washington and the Baltimore-Annapolis Boulevards:

| Year | Overhead Expenses | Miles Constructed | Total Cost of Roads | Average Overhead Expense Per Mile | Percentage of Overhead Expense on Total Expenditures |
|---|---|---|---|---|---|
| 1908<br>1909<br>1910<br>1911 | $154,492.02 | 131.64 | $1,556,444.55 | $1,172.59 | 9.926% |
| 1912 | 54,197.22 | 138.99 | 1,505,941.49 | 389.94 | 3.598% |
| 1913 | 59,762.59 | 186.04 | 1,717,902.19 | 321.24 | 3.478% |
| 1914 | 95,496.97 | 226.85 | 2,889,340.65 | 420.97 | 3.305% |
| 1915 | 81,946.89 | 190.98 | 2,147,440.88 | 429.09 | 3.815% |
| Totals | $445,895.69 | 874.50 | $9,817,069.76 | $ 509.89 | 4.542% |

It is not possible to separate the overhead expenses for 1908 to 1911, inclusive, by years, because the system of bookkeeping used during that period does not permit it.

In the July issue of Better Roads and Streets we will present the operation and accomplishments of the Maintenance Department of the Maryland State Roads Commission, this being one of the most progressive States in the country in maintaining the roads, once they have been built, and the description of which will be most interesting.

* * *

## North Carolina

The itinerary inaugurated by the State Highway Commission in co-operation with the United States Office of Public Roads, for the purpose of establishing a systematic maintenance system for the Central Highway of North Carolina, beginning at Morehead City and to end at the Tennessee line was begun at Morehead City last month.

The parties composing this itinerary consisted of Mr. E. W. James, chief of the Division of Maintenance of the office of Public Roads, and Mr. D. H. Winslow, Engineer in charge of the Northern Carolina division of maintenance on the Washington-Atlanta Highway; Dr. Joseph Hyde Pratt, State Geologist and Secretary of the State Highway Commission, and W. S. Fallis, State Highway Engineer.

The purpose of this itinerary was carried out by the co-operation of the counties through the official road bodies of the counties. The counties were requested to take official action at the meetings arranged for during the itinerary, apportioning such funds for the purpose of maintaining the mileage of the highway through the various counties as estimated by Mr. Winslow and Mr. James to be necessary for such maintenance.

The control of this maintenance will be placed in the hands of an experienced maintenance engineer of the United States Office of Public Roads, who will be furnished for this purpose free of all cost to the counties. It is expected now that all arrangements will be completed and the work ready to begin by the 15th of May.

The general plan for this work is the same as is now so successful in operation on the Washington-Atlanta Highway. The State Highway Commission, realizing the success of the work now under the control of Mr. Winslow and Mr. Spoon on the Washington-Atlanta Highway, feel that the counties of the State through which this road passes have taken advantage of a great opportunity for the Capital to Capital Highway through this arrangement.

This project will, in a short time, give to the travel going East and West through the State the same advantage that is now being enjoyed by the travel over the Washington-Atlanta Highway, which afforded on that highway during the past year a road from Petersburg to Atlanta that could be used the entire three hundred and sixty-five days of the year without either chains on automobiles or non-skid tires being necessary. The advantage of this to the State is obvious, and it is gratifying to the Commission that this project has been successfully inaugurated.

The hearty co-operation given the itinerary from the counties through the whole route was even better than was expected at the beginning of the project by the State Commission; some of the road boards, or county commissioners even doing more than was asked by the State Commission, when the boards realized the advantages that would come to them through this project. All the counties visited took official action and agreed to fully co-operate in the maintenance of this highway, and in most cases generously extended support indirectly, as well as directly, to the project. It was the intention of the office of

Public Roads and the State Highway Commission to carry this maintenance scheme on through to the Tennessee line, but owing to the condition of the roads in Burke County it was impossible to carry it further, and so the counties of Burke, McDowell, Buncombe, and Madison will not at present participate in the advantage of the project.

The value of this project is many-fold, and is not altogether local in the benefits that will be derived by any means. Each community through which this road passes will place itself in direct communication with its neighbors and county seats and through that county with the counties adjoining and in connection with other improved highways with large portions of the entire country.

Another advantage that will accrue from this maintenance system is the value of the training in maintenance that will be afforded the county road authorities through which this system of maintained highways will pass; they receiving the benefit of the experience brought to them through the engineers of the office of Public Roads, who have at their command through the other engineers the experience gained through the entire United States along maintenance lines, thus enabling them to secure information regarding the best methods of handling maintenance projects, the proper methods of carrying these projects out, the most economical equipment for the purpose as fitted to the different kinds of climatic conditions, and the different kinds of traffic on the roads under their charge. And for these and many other reasons this maintenance project will be invaluable not only to the counties through which this road passes, but to the State as a whole.

The counties through which the Central Highway of North Carolina is routed, beginning at the Atlantic Ocean on the East are as follows: Carteret, Craven, Lenoir, Wayne, Johnston, Wake, Orange, Alamance, Guilford, Davidson, Iredell, Catawba, Burke, McDowell, Buncombe, Madison. An alternate route through the counties of Forysth and Davie will be placed under this scheme for maintenance.

*Sampson County.* The county prisoners are still working on the road from Roseboro to Clinton, and there are several squads of hired hands in the county. There have recently been built about six or eight miles of road between Clinton and Faison. The County has recently bought an engine and grader to be used in the up-keep of the roads that have been built. While the road work in Sampson County is yet in its infancy, in a few more years we are sure there will be a splendid system of good roads in this county.

*Caldwell County.* During the past month Lovelady township, Caldwell County, has graded and top-soiled about three miles of road. They have also completed and turned over to the public the $3,700 bridge across Gunpowder Creek.

*Cabarrus County.* The four squads working on the public roads leading out of Faith have put in good shape about eighteen miles of road. Mr. M. G. M. Fisher is one of the foremen of these squads.

*Catawba County.* It is stated that the sand-clay road to Dudley Shoals is completed, and that the force will be moved to begin a two mile stretch from Gunpowder toward Petra and will then build the road from Graces Chapel about three miles, as soon as the bridge across the new dam is ready.

*Cleveland County.* Number 2 Township has sold its bonds, which amounted to $40,000. These were bought by J. H. Hiltsam Company, of Atlanta, Georgia.

*Columbus County.* This County has recently bought five more splendid mules, and with these, together with the ones they had already, and with the forty-three convicts which they are working, they are expecting to make a good show in road building. Several new sections will be taken up along what is known as the Wilmington-Charlotte and Asheville Highway, and before long sixty miles of this road will be in fine condition. They are going to put White Marsh and other bad swamps in good condition as early as the weather will permit. It is the intention of the commissioners to build good roads across the entire county, thereby putting all the people within a short distance to a good highway from any part of the county. It is gratifying to all concerned to see the prospect of many miles of good roads added to the other links in the county during this summer.

*Cumberland County.* About seven miles of the Yadkin road leading from Fayetteville to the Hoke line has been completed. It is a beauty and a real sand clay road instead of sand road as most of them are in this section of the State. The road has been ploughed up and the sand and clay thoroughly mixed so as to make a solid road bed with proper drainage provided for. Cumberland has now some splendid roads leading in every direction, and when the Yadkin link is completed and another link which is to connect with the Wilmington Highway by Clinton then Fayetteville will have a most splendid system of roads at small cost.

Hoke is to build a road to the line to meet the Yadkin road which will give to the traveling public a fine highway leading from Wilmington to Fayetteville, and from Fayetteville to Southern Pines and Charlotte. This county now has about 250 miles of improved roads out of 480, which makes a good showing in road building.

*Davidson County.* At a recent meeting of the Highway Commission it was ordered that the road from Thomasville to Holly Grove be built by way of the new cut road, and the old Raleigh Road. It was also ordered that two surveys be made from Thomasville under the direction of Eller along the road known as the Turnpike.

*Franklin County.* The bridge that is being built in Louisburg, under the supervision of the State Highway Commission is progressing very nicely. The construction of this bridge is in charge of Mr. George F. Syme.

*Guilford County.* It has been decided by the road officials of Guilford county that the Greensboro-High Point concrete road which will be built will follow the old route direct to High Point, with the exception of a change at the Greensboro end, which will enable the straightening of a bad curve at the Fair Ground to be made; but the Guilford Station faction will have a chance to secure a mile and a half additional to the concrete highway which runs past Lindley Park.

*Harnett County.* It is reported that about one hundred miles of road has been built in four townships in Harnett county. Lillington Township had a bond issue of $20,000, and has built about fifteen miles of road. Upper Little River Township had a bond issue of $10,000 and have built forty-three miles of road. With a bond issue of $10,000 Hector Creek Township built twenty-three miles of road; Barbecue has built twenty-seven miles. Anderson's Creek has issued $10,000 for roads, Stewart's Creek $15,000, and Black River, $25,000. These townships are now building roads with the money from these bonds. There have been seven townships in Harnett County to issue bonds. Much of the territory in that county will be covered with improved roads when this money is all spent.

*Lenoir County.* The work on the Lower Creek road is progressing well. About a mile of the road has been graded and made ready for top-soil. Work begun a short time ago on the road from Collettsville to the Blowing Rock Turnpike. The plan is to have a first-class road from Collettsville to Lenoir, the first link to be completed being that between Olivet and Warrior. Later the road will be improved from Olivet to Collettsville, and the progressive citizens who are behind this enterprise are now hoping that the road will be completed and ready for use by spring or maybe early summer. The work is being done by volunteer labor.

*Pitt County.* There are five townships in Pitt county which have voted $50,000 bond issues; they are Carolina, Chicot, Farmville, Falkland, and Greenville.

*Richmond County.* The work on the Ferry road is progressing rapidly. This is being built by Richmond County to join the road being built in Anson County to connect with the Ferry over the Pee Dee River about 12 miles from Hamlet. Just as soon as the roads are completed the Ferry will begin. This will cut off at least 30 miles in the travel from Hamlet or Rockingham to Wadesboro, and will shorten the distance from Charlotte to Wilmington the same. In order to go from one side of the Pee Dee River to the other it has been necessary heretofore to go by Chrew, South Carolina, and this Ferry will eliminate the necessity of this.

*Rowan County.* From Salisbury to Woodleaf there is a fine sand-clay road being completed, the work being done by the county chain-gang.

# The Accomplishments of the Philadelphia Bureau of Highways

By William H. Connell, Chief of the Bureau of Highways and Street Cleaning

(*Continued from May Issue.*)

While planning boards have been used with success in some of the industrial establishments, the application of this method of carrying on the operations of a large highway department is new, and after several months' trial has proved an unqualified success, and one of the most practical schemes that has thus far come under my observation for simplifying the management of such a department. For some time past we have indicated certain data on maps, such as the progress of contracts, etc., but the planning boards referred to are used as a means of control of the entire operations of the department other than such work as is performed in accordance with a fixed schedule.

These planning boards have been placed in the offices of the chief engineer, the two division engineers in charge of general highway work, the division engineer in charge of bridge and sewer maintenance, and the seven district highway engineers.

They consist of a map indicating in different colors the character of all the pavements and the unimproved streets throughout the city, mounted on a board and encased in a frame. The scale of the map is such as is necessary to contain the information desired in each specific case; for example, the scale of the district engineers' maps, which contain the locations of holes in the pavements, etc., is necessarily greater than that of the chief engineer's map, which does not show such detail.

The scheme is a very simple one, and it is not difficult to operate. The status of contract and municipal repair work, bituminous surface treatments, etc., and the location of the repair gangs, and all other information contained on the boards, is indicated by pins with heads of different colors, shapes, and sizes.

This method of visualizing the status of the work also enables the executive to readily give information concerning the operations under his jurisdiction that would ordinarily necessitate 'phoning to the offices where the records are kept, which would mean a delay of several minutes before the information could be obtained from the record files, whereas with the use of the planning board and visible card index system, it is possible to obtain the necessary information in less than a minute, and this saving of time means a great deal to a man interviewing a number of people every day requesting such information.

### WORK PERFORMED BY MUNICIPAL FORCES

The system of keeping cost data on all work performed by municipal forces that was instituted two years ago, has been, of course, continued and amplified, and much of the increased efficiency of the labor forces has been due to the posting in each office every two weeks of the costs of the work performed by the various gangs and different districts, thus establishing a sort of friendly competition, and creating a stimulus toward better and more effective work.

The municipal forces employed on repairs to paved streets have been reorganized into certain unit gangs, thus putting the work performed by any unit of the organization on the same basis as the other units for the purpose of comparison, and since the introduction of the planning boards, the proper routing of the work of the repair gangs has been very much simplified. This is one of the greatest advantages accruing from this method of handling work, for it has been amply shown that effective planning and routing of the work is one of the greatest factors in securing economy of operation.

The detailed studies in connection with the reorganization work, the results of which have been more in evidence than ever this year, have frequently been referred to by the author, and it might be said that the operations of the department have been carried on during 1915 under more normal conditions than during the previous three years. This is evidenced in the decreased unit cost of some of the work performed under the municipal forces; for example, the cost of bituminous surface treatment is one cent per square yard less than last year, and as there were 1,754,014 square yards of roads treated, this saving amounts to $15,740.14 during the year. As a result of making detailed studies of the work performed by the municipal repair forces, the methods of carrying on the work have been greatly improved upon and the unit costs per square yard have been so reduced that the city has saved approximately $80,000 in 1915, through being enabled to repair 225,000 square yards more than could have been done under the appropriations for this work at the 1914 cost per square ward for the same class of work. This, together with the saving in bituminous surface treatments, or our country road paint coat work, of $15,740.14, shows a total saving in 1915 of $95,740.

This is only an illustration of the possibilities of stopping up the leaks through scientific studies with a view to improving upon the methods of operation, and in this there is an unlimited field, as will be seen from the following review of the extent of the operations coming under the jurisdiction of the Bureau of Highways of Philadelphia.

During the year 1915, the number of contracts awarded aggregated 835, including those for grading, the construction and maintenance of streets and roads, the collection and disposal of garbage, ashes, and household waste, street cleaning, and the maintenance of bridges and sewers. The value of these contracts was $7,849,568.32, of which amount $5,027,-854.05 was actually expended during the year. In addition to this contract work, there was expended for work done by municipal forces on the maintenance of streets and roads, bridges, and sewers, the sum of $770,292, making a total of $6,798,146.05 which was actually expended by the Bureau in construction and maintenance work during 1915. The engineering and overhead charges, which include transportation and all office expense, etc., were $377,784.75, or 5.26 per cent. of the total expenditures of the Bureau, the latter amounting to $7,175,930.80.

There were also bids received on work aggregating a total value of $1,025,381.21, the work on which has not yet been started. This amount, added to that of the contracts in force and the cost of work performed by municipal forces, together with the overhead charges during the year, brings the total value of the operations to $10,023,026. The total mileage of highway construction in Philadelphia during the year (1915), which includes city pavements and suburban country roads, was as follows:

| | |
|---|---|
| Bituminous roads | 34.80 miles |
| Granite block | 1.39 miles |
| Cement concrete roads | 1.40 miles |
| Grading | 21.15 miles |
| Sheet asphalt | 27.06 miles |
| Vitrified brick block | 5.41 miles |
| Water-bound macadam | 18.35 miles |
| Wood block | 3.17 miles |
| Total | 112.73 miles |

There are now 1,126.61 miles of improved roads in the city. There are also 91.786 miles of bituminous roads, 246,024 miles of water-bound macadam roads, 0.35 miles of granite block pavement on hills, 2.52 miles of cement concrete roads, and 188.45 miles of dirt roads and graded streets, making a total of 1,655.74 miles of streets and roads within the corporate limits of the city of Philadelphia.

The work of the department also consists in the maintenance and cleaning and repair of 1,337.07 miles of sewers and 301 bridges, as well as all street cleaning and the collection of ashes, garbage and rubbish.

The total yardage of pavements in the city is 18,041,448, part of which is cleaned every day, part every other day, and part every third day, depending upon the necessity. The average yardage cleaned per day was, last year, 9,873,152, or a total of 3,060,677,120 square yards of city streets cleaned during the year.

The total yardage of surfaced country roads is 4,099,217, and the cleaning periods vary from once a week to once a month. The average yardage of country road cleaned per day

is 341,601. The total yardage of pavements and country roads cleaned during the year was 3,166,574,000.

There were also 2,481,748 cubic yards of ashes, rubbish, and garbage collected from 350,000 households, or an average of 70.9 cubic yards per household, and based upon the population of 1,675,000, the city collected and disposed of 1.48 cubic yards, or 1,222 pounds of household waste per capita during the year. Other work, such as repairs to river banks, the campaign for the extermination of mosquitoes, etc., also comes under the jurisdiction of the Bureau of Highways and Street Cleaning.

This summary indicates to some extent the necessity for simplifying as far as possible the operations of such a department, and after thoroughly systematizing the work, experience has proved that the use of planning boards will do a great deal toward accomplishing this result.

### BITUMINOUS SURFACE TREATMENTS

The use of bituminous surface treatments, commonly called paint coats, on water-bound macadam roads has been one of the most popular innovations instituted by the Bureau in Philadelphia, and has entirely transformed these roads, so that the once-upon-a-time dusty road is a thing of the past in Philadelphia. These water-bound macadam roads treated once a year with bituminous material and covered with silica gravel or hard stone chips have a surface which not only presents a more pleasing appearance, but which resists the wear of traffic, thus reducing the tendency to form



Sweeping Macadam with machine broom prior to applying bituminous material. Sprinkling wagon immediately precedes the machine broom.

pot holes. The freedom from dust of these surface treated roads also adds materially to the comfort of the public and saves the city the usual cost of sprinkling.

When bituminous surface treatments were first started by this Bureau in 1912, there were only a few of the water-bound macadam roads that were in condition to warrant this method of treatment, but the efforts of the Bureau in repairing the roads have been so successful that at the present time practically all the water-bound macadam roads have received bituminous surface treatments. The roads which are not in good repair are covered with a road oil which serves as a dust layer, but this material is now seldom used on the water-bound macadam roads. It is, however, still employed quite extensively on the dirt roads, where it minimizes the dust nuisance.



Hand brooming after the machine brooming precedes the application of bituminous material and insures a clean surface which will be free from dust, which is absolutely essential. Foreman and twelve men comprise the hand brooming gang.

The average cost of surface treating water-bound macadam roads in 1913 was 7.3 cents per square yard; in 1914 it was 5.8 cents per square yard, and in 1915 it had been reduced to 5.03 cents per square yard, or a saving in three years of 2.27 cents per square yard, this reduced cost being due both to the increased efficiency in the methods of performing the work and to the decreasing amount of bituminous material required for this treatment each year. During 1915, 149.1 miles of roads were given bituminous surface treatments, and 111.0 miles were treated with a dust layer.

### COUNTRY ROADS

In 1912, the county roads of the city of Philadelphia were almost without exception in deplorable condition, and as the funds for country road work are always limited, the policy was instituted of placing the important through routes in first-class



Applying Bituminous Material with a Motor Driven Pressure Distributor. Piles of Silica Pea Gravel or Stone Chips are seen conveniently placed along the road.

condition and expending on the less important routes only sufficient money to keep them safe until funds became available for their improvement. In 1912, the most important thorough routes were placed in condition, and in 1913 and 1914, all the important routes were improved, together with many of the secondary routes. This construction was so thorough that practically no maintenance has been required on the original construction, thus leaving all the funds recently appropriated for the improvement of the less important roads, and at the end of the year 1915 it may be stated that practically all of the macadam roads of the city are in good condition.

The policy instituted in 1914, consisting of the construction of a concrete base for the bituminous roads, instead of laying the bituminous wearing surface directly on the old macadam road was continued throughout 1915, for it has been definitely demonstrated that such a construction, although costing from ten to fifteen cents per square yard more, in the first cost, will



Applying Silica Pea Gravel or Stone Chips following the application of Bituminous Material

so increase the life of the pavement and so cheapen the cost of the renewals of the bituminous surface when these renewals are necessary, that ultimately a considerable economy will be effected.

Practically the only important macadam roads in the city of Philadelphia which remain in poor condition are those occupied by the three independent railway companies which operate in the city. The franchises of these three companies provide that they shall maintain the entire width of the streets and roads traversed by their lines, but through the advent of the automobile, the character of traffic on these roads has so increased the cost of maintaining the pavement that the railway companies claim to be financially unable to place the roads in the condition that their location and the traffic necessitates.

The worst road traversed by the lines of any of these three companies is on Frankford Avenue from Bristol street to the county line. During the year 1914, an attempt was made to secure better conditions by notifying the railway company that their cars would be prevented from operating if repairs were not commenced at once, but the company secured an injunction against the city, restraining it from preventing this operation of the cars, and although effort has been made to bring the matter to an issue, the case is still pending in court. It is of first importance that these roads should be repaired, as their condition is such that sooner or later some serious accidents will occur. If the responsibility for the maintenance of the entire width of the road is too much of a burden to place on the railway companies, some agreement should then be entered into between the city and the railway companies, by which better conditions may be obtained, for these roads are steadily becoming worse, and the Bureau of Highways is, in the meantime, powerless to take any action, as no funds have been made available for this purpose.

### GRADING

During the year 1915, there have been in force 192 contracts for grading streets, and in each case the work performed under these contracts has had a marked influence upon the development and land values in the adjacent territory. A number of these grading contracts were of considerable size and importance. Several other very important contracts were awarded for grading during the year, which, however, have not yet been started.

### SNOW ALARM, OR PREPAREDNESS IN THE REMOVAL OF SNOW

Another innovation introduced by the Highway Bureau, and which has been operating successfully for the past three years, is the snow alarm, or preparedness in the work of the removal of snow. The conception and operation of the "snow alarm" in Philadelphia is one of the unique improvements in the Bureau of Highways, which has resulted in greatly benefiting the community. Formerly it was the custom, not only in Philadelphia, but in other cities, to wait until the storm was over before beginning the work of removal. In other words, the city did not begin to dig itself out until after the storm had ceased. As a consequence the traffic on the streets was often very seriously congested.

The main idea in a snow removal organization is "preparedness." At any hour of the night, as soon as the snow starts to fall, the Electrical Bureau notifies the Chief of the Bureau of Highways and the engineers in charge by telephone in their respective homes. One engineer living in the central part of the city is in constant communication with the Weather Bureau and the Chief of the Bureau of Highways, and as soon as the indications point to a continuance of the storm, the snow-fighting equipment is ordered out, upwards of one thousand telephone messages being sent to various parts of the city, calling out squad leaders, inspectors, snow-plows, drivers, teams, laborers, and officers in the various police districts, who aid in getting out the men.

In about one hour after the order is given, the motor-driven and horse-drawn plows attack the snow in the central business section of the city. These plows are supplemented by an army of laborers and teams, which are kept constantly at work, day and night, shoveling and dumping the snow into sewer manholes and into the Delaware and Schuylkill rivers.

Every man in the snow removal organization has a particular function assigned to him. For instance, each dump inspector knows his post is at a certain dump, and he knows just what to do when he gets there; the driver of every snow plow and of every team knows where he is to report, at what point he it to start to load, and at what sewer, manhole, or wharf he is to dump his loads, and there is no confusion.

Fighting the snow at night during some of the storms we have had in the past three years is no easy task for the Highway Bureau engineers assigned as squad leaders, the inspectors, contractors, and the laborers, and it requires the constant presence of the Chief of the Bureau and his principal assistants to encourage the men and to stir up the necessary enthusiasm to keep the work going.

In the central business section of the city, snow is removed from all the thoroughfares. The work is performed under special contracts supplemented by the regular street cleaning force and is under the supervision of a special snow removal organization made up of men assigned to this work from the regular engineering staff.

Certain main thoroughfares and all the street crossings throughout the entire city are also cleaned by the regular street cleaning forces, and a large municipal force is assigned to the seven highway district engineers who supervise this work. A large force is always employed opening up the country roads where the drifts often completely block traffic. All told, the force employed on snow removel consists of an army of 4,000 men, 1,200 teams and an advance guard of 38 horse-drawn and 20 motor plows.

### WORK OF THE PERMIT DIVISION

During the year 1915, there were issued to plumbers 6,363 permits, authorizing 8,907 openings in the streets, which involved cutting out approximately 28,000 square yards of pavement, in addition to 19,612 permits issued to the Bureau of Water and the several public service corporations for the installation of underground structures, authorizing 19,612 openings and involving approximately 167,836 square yards of pavement, and making the total number of permits issued by the Permit Division 25,965, of which 1,181 permits were approved by the Board of Highway Supervisors. The total number of permits issued authorized 28,519 openings and involved approximately 195,836 square yards of pavement, which would be equivalent to the opening and repaving of the full width of 12.8 miles of roadway 26 feet in width.

The enforcement of the use of a standard design for footway shelter to protect pedestrians during building operations has resulted in a marked improvement of the appearance of the highways in front of building operations. One of the most unsightly street conditions prevalent in former years was due to the unregulated erection of scaffolding and building bridges in front of buildings in the course of erection. At the instigation of this Bureau and with the collaboration of the Bureau of Building Inspection, standard designs were prepared for these bridges and were submitted to the Art Jury, who, under the powers given them by the State Legislature, authorized that all building bridges be constructed in accordance with this standard design. The improvement that resulted in street appearance has been very noticeable, and has caused much favorable comment. While this is relatively a minor matter, it is one of the countless number that go to improve the aesthetic appearance of the streets, and enhance the attractiveness of the community.

During the year 1915, the Permit Division examined 1,710 building plans on which encroachments on the highways were indicated, it being the duty of the Buerau of Highways to approve or disapprove all structures to be located on the highways between the building lines. In general, if the encroachments were of a character authorized by either an Act of Assembly or by Ordinance of Council, the plans were approved; otherwise they were disapproved.

Prior to the issuance of permits for the erection of awnings, the Permit Division submitted the proposed designs to the Art Jury of the city of Philadelphia, and only upon its recommendation were permits issued, provided, however, that the proposed structure conformed to the requirements of the existing Ordinance of Council. The awnings now being erected are of such design that they do not present an objectionable appearance.

The Permit Division in 1915 issued 37,154 permits and licenses, for which the sum of $67,635.18 was received.

The following table shows the character of the pavements that were cut into, and the number of openings that were made in each type:

| | |
|---|---|
| Asphalt block | 69 Openings |
| Bituminous macadam | 78 Openings |
| Cement concrete | 47 Openings |
| Cobble and rubble | 48 Openings |
| Sheet asphalt | 6,935 Openings |
| Stone block | 10,376 Openings |
| Unpaved | 3,458 Openings |
| Vitrified brick and block | 2,122 Openings |
| Water-bound macadam | 941 Openings |
| Wood block | 243 Openings |

| | |
|---|---|
| Footways | 2,523 Openings |
| Tunnels | 1,679 Openings |
| Total | 28,519 Openings |

THE BOARD OF HIGHWAY SUPERVISORS

The Board of Highway Supervisors, whose duty it is to prevent frequent and unnecessary openings in highway pavements, and to promote system and economy in restoring pavements over openings made necessary by the introduction or repair of underground structural work, met regularly twice a month throughout the year. This Board recommended permits covering 70.31 miles of conduits and pipes during 1915, for which the sum of $8,619.45 was paid by public service corporations and others for the use of the records on file in the drafting room.

The Supervising Engineer made reports on all matters to be brought before the Board. Among the more important actions by the Board was the adoption of a set of rules and regulations governing the opening and structural occupancy of highways as consolidated and revised by a Committee consisting of George S. Webster, Chief of the Bureau of Surveys; Clayton W. Pike, Chief of the Electrical Bureau, and William H. Connell, Chief of the Bureau of Highways, Chairman. These revised rules and regulations, which are composite in character, cover all classes of structural work and replace the six separate sets of regulations formerly in use covering the several specific classes of structures. Another important action was the appointment of a committee consisting of George S. Webster, Chief of the Bureau of Surveys; Clayton W. Pike, Chief of the Electrical Bureau, and William H. Connell, Chief of the Bureau of Highways, Chairman, to consider means of preventing the breaking of newly paved streets by public service corporations for the purpose of installing service connections. This committee presented the following resolution, which was adopted by the Board:

*"Resolved,* That in all cases where gas, water, electric current and telephone mains and conduits are installed in a highway and the location for the laterals cannot be determined in advance, laterals or services be installed every sixteen feet, or the mains and conduits be laid on both sides of the highway before the pavements are constructed. In the case of the gas mains, they shall be laid three feet outside of the curb; in the case of water, electric current and telephone mains and conduits, they shall be assigned footway locations on both sides of the highway.

*Be it Further Resolved,* That the several public service corporations and municipal departments affected by this resolution be so notified."

The installation of service connections after a highway has been newly paved results in more or less injury to the durability of the pavement and detracts from its smoothness and appearance, and therefore it is necessary that the requirements of this resolution be rigidly enforced.

The work of revising and bringing up to date the plans showing structures occupying the highways on file in the drafting room, and in obtaining data for new ones, was prosecuted continuously throughout the year. During the year 1915, new surveys were made of the structural conditions existing on 237 miles of highways. The field work data was plotted and recorded in pencil on cards eight by eleven inches in size, and these plotted plans will be worked up in permanent form as quickly as possible. In the meantime, the data recorded on these cards in the field is in such shape as to be readily accessible for guidance in assignment of locations for proposed new structures.

(The continuation of this interesting series of articles by Mr. Connell will be published in the July issue of BETTER ROADS AND STREETS).

* * *

## The Adaptability of Northern Michigan's Trunk Line Roads to Summer Touring

KIPLING expresses the sentiment that the American people have not yet learned to mix themselves into their scenery or something of a similar nature at least. This is due in part to the natural tendency to tend to business even when upon a vacation, and in bygone days the vacaton to many meant a trip to some duly advertised, artificial resort or a scheduled tour. Today the auto has entered the field not alone of commercial business, but as a factor of the business of pleasure, and it is more and more becoming the vogue to have an auto tour supply the needed vacation.

An auto tour may be of several kinds, ranging from simply a joy ride to a transcontinental trip, but there are many trips in the mid-ground, that are desirable and which are open to the touring public at a varying range of cost, and to chronicle the possibility of a few of these, as related to the laying out of a commercial highway system, is the purpose of this article

The country of which this article speaks, namely, the Upper Peninsula of Michigan shown on the accompanying map, can be reached, let us say from Chicago, by a straight drive north passing across the eastern part of Wisconsin and through the metropolis of that State, Milwaukee.



It has been reported that the drive from Chicago to Menominee, the first point reached on the Peninsula, has been made in one day, but that means hard driving. It can be comfortably reached in two short days' driving from Chicago in any good season. Menominee once reached, the tourist has the choice of going to Escanaba along the lake shore drive, a good road over part of its length and passable in its entirety, a distance of some sixty miles. Having pretty, natural scenery with occasional stretches along the beach of Green Bay and more stretches through uncut woods and fishing hamlets, he can drive some forty miles straight north along the trunk line route over good roads, through several villages and a country for the most part settled up and farmed, to a town called Spalding.

At Spalding the tourist can turn west to Iron Mountain, traversing a road all the way, which is easy to drive over in



any make of car, but inasmuch as we can get to Iron Mountain on a circuit tour by proceeding east, we will route this trip in that direction and go east along the line of the main trunk line road through several small farming towns to the city of Escanaba, being sixty-four miles from Menominee by the trunk line road and over a route customarily driven in about two and one-half hours. From there we can proceed on over macadam roads to Rapid River, a saw-mill and farming town. Again the trunk road forks and a turn to either direction will lead to a tour of moderate length.




Proceeding east from Rapid River, you come to the end of the present macadam construction at Ensign, and there are about twenty miles of road to be made, which is but little more than passable. The plans for the season of 1916 will span the greater part of this gap with a good grade and part of it surfaced when carried to completion. This stretch is also over pine plains and for the most part has but slight scenic merit. It leads to the end of a macadam road, which will carry you into Manistique, a fair-sized lumber city upon Lake Michigan, a good point for resorting in itself and surrounded by several lakes, also nice points for camping. Continuing east over the macadam road you again come to the end of the stone at Whitedale. Here an abrupt turn to the left carries you over a good earth and gravel road to Blaney. In the near future a line of the trunk line road will lead east from Blaney, taking you across the length of Mackinac County and in many



places through delightful surroundings. This line is now under construction, but will likely not be open to traffic for a season or two. Therefore, this trip must be continued on north to Germfask, at which point the trunk road turns east and for four or five miles travelers must go over a road which is passable but in wet weather decidedly not good. Should the tourist be desirous of a side trip fishing expedition, he can turn aside to the north over roads which the author has been over in fair security in an auto and attain points where excellent brook trout fishing may be had and also gain the heart of the country that supplies considerable of the deer hunting. Before doing this it is best to consult the game laws, however, and comply with them as moderate protective measures for all forms of game have been enacted and any breach of the laws, which in themselves allow a reasonable latitude to the sportsman, is apt to result badly for the offender. But to continue east from Germfask, after making the short run through the woods, which, barring the fact that in wet weather the road is not good, is really a very pretty drive, skirting a river for most of its length, a stretch of farming country is reached where good roads lead you by Manistique Lake, a good fishing resort, and then soon you will come up with the construction gangs again and from thence on into Newberry, the drive is over a high-class gravel road. Leaving Newberry, a drive southeasterly of about eight miles brings you to the end of the construction of the trunk line road as now built. The gap from here to the corresponding end in the next county is now partly under construction. This does not bring you to the end of this journey, however, as you can turn southerly into a road through uncut forest of maple and beach and make a very pleasant drive of approximately twelve miles over a trail which is not graded, but on which the running is very good and except for the fact that a sharp lookout for other autos is necessary because the trail is but a one track affair, this road is a real pleasure to drive and brings the tourist a touch of the uncut wilderness with its flowers and natural game and birds.

You next come out at the station of Rexton upon the Soo railway, where a turn to the east and a stretch of road which is not good, but is passable, lies ahead over which you must go for about ten miles to Trout Lake at which point you again meet the grade of the trunk line road. The grade from thence on leads you through a farming country, which is comparatively flat and where not cleared, is heavily wooded. The road for the next stretch has really no surface metal upon it, but the clay of which it is made, is covered for a most part with a light coat of gravel so that except in extremes of weather, it is good to travel. A few hours run brings the tourist to Rudyard where a turn can be made either directly north to Sault Ste. Marie or the run may be made to the Les Cheneaux Islands, which are one of the time honored summering spots of Michigan and from there a good road leads for thirty odd miles to the Soo, also too well known to need comment. Returning, the traveler may route himself over any of the alternate routes mentioned before.

But supposing that on reaching Escanaba, the traveler prefers to tour the mining country and its surroundings, he has the option of turning off at Escanaba and following a branch trunk line to Negaunee or going over to Rapid River and following the main trunk line road to Marquette. Both are good roads to travel except for a short stretch near the middle of each and it is expected that the grading work will close the gaps on each of these roads in the next season. From either of these runs a side trip to Munising is possible over several routes, all leading through stretches of farming country and uncut forest. Once at Munising there is the possibility of excellent lake fishing or if Lake Superior be in a quiet mood,

a run by gasoline or other boat down past the "pictured rocks" or to one of the many islands, may be had.

Back to Marquette again, the tourist finds a town well known in history, prettily situated on Lake Superior and with a metropolitan appearance. From there a run of fourteen miles over a macadam road brings you to Negaunee and the mining country. The trunk line leads from thence practically along the mineral formation, and you pass first the city of Ishpeming and then several other mining towns until finally you reach Michigamme on the shores of the lake of the same name, a lake well stocked with fish and surrounded by innumerable desirable camping grounds, a few of which are now utilized.

On this run the tourist has been on good road all the way, but to continue to the "Copper Country" or copper mining region, the trunk line road is not yet built across one county and it is now necessary to go over the summit by a road that should not be driven except in good weather and then only by good drivers.

The "Copper Country" once reached, there are many fine short trips to be had all through pretty scenery of hills, lakes, settlements, and forests and over excellent roads.

But should the trip over this bad stretch of road be undesirable it is possible to return to Humboldt, but nine miles back along the main trunk line where a turn to the south will lead straight into Iron Mountain, all the distance over good road and through wild and more or less rugged scenery. Here the tourist finds himself upon the Menominee Iron Range. He can now turn east to Spalding or swing west and continue upon good road, through Crystal Falls and Iron River and then by a big jump, but all over good road, reach the Gogebic Iron Range and ultimately the city of Ironwood, three hundred miles from the Soo as the crow files and on good roads, except as mentioned. From any of the points as named, side trips may be had and fine places for camping, fishing, etc., are available and in many places, as at Lake Gogebic, are spots of scenic beauty.

Return may be made usually by a different route or circuit.

Now as to "grub," etc., as the lumber jack calls it, a thing of considerable moment when touring in this northern air. There are several ways the tourist can arrange for himself. There are good hotels at Menominee, Escanaba, Manistique, Newberry, Sault Ste. Marie, Marquette, Haughton, and Ishpeming. Negaunee, St. Ignace, Iron Mountain, Crystal Falls, Iron River, Ironwood, Powers, and in fact most any of the larger towns can make the traveler comfortable and they are, in all instances, within easy stages of each other. But should the tourist wish to camp, there are many spots where desirable camping privileges may be had, and a letter addressed to the Upper Peninsula Development Bureau will probably supply the necessary information as to camping privileges, probably costing little or nothing and subject to none but reasonable conditions as to fires and the like. ( N. B. This has not yet been arranged for).

A light tent, bedding, and cooking utensils can supply the camp equipment. The numerous towns will furnish all necessaries for the auto and provisions, which can be further added to from the natural resources of fish and game, and a trip may be had in practically any style the traveler pleases at a corresponding but not exorbitant expense.

* * *

## Oklahoma

### Construction and Maintenance Funds

**By W. P. Danford, Assistant State Engineer**

CONSTRUCTION

The Oklahoma Highway law provides that the State shall make an annual levy of one-fourth of one mill upon all taxable property within the State, "and when collected to be placed in the State depository to an account to be styled and known as the State Highway Construction Fund." Further, "all counties having made such levy for any year, and having otherwise complied with the provisions of this act as to submission and having plans approved, are entitled to receive from the State Highway Construction Fund the amount so collected from that County."

The money in the State Highway Construction Fund is paid out by the Commissioner of Highways upon receipt of application from the various counties if the application and the records in the Highway Department show that the applicant county has complied with the law in making a one-fourth levy and in the expenditure of same. In brief, the county commissioners must appoint a county engineer who has passed an examination and holds a certificate of competency from the Department of Highways authorizing him to act in this position. The county commissioners must also designate a Sate road system (consisting of from ten to fifteen per cent. of the main traveled roads of the county) and after same has been approved by the Department of Highways the county engineer shall divide the system into sections and proceed to survey and make plans, profiles, and estimates of those sections that are in need of immediate improvement, submitting all such plans, profiles, etc., to the Department of Highways for approval.

Counties complying with these provisions are entitled to receive from the Commissioner of Highways the money that is to their credit in the State Highway Construction Fund.

At the time this article is written, applications have been received from thirty-three of the seventy-seven counties and eleven of these applications have been granted, the total paid out amounting to $20,773.56. Eleven applications have been approved but are held pending receipt of additional data from the counties. The remaining eleven applications have been disapproved because county commissioners have not sufficiently complied with the Highway law. From the records of the Highway Department and from observation and information secured from various sources it is plainly evident that the best results in road and bridge building are being obtained in those counties that are complying or attempting to comply with the Highway law in expending their funds.

It is estimated that the State Highway Construction Fund this fiscal year will amount to about $225,000.00. If the county one-fourth mill levy equals this amount it is evident that approximately $450,000.00 will be spent on the State roads of Oklahoma during this fiscal year by the county commissioners, which amount is intended to be expended in accordance with plans approved by the Department of Highways. This is exclusive of the Road and Bridge Fund which is used for the construction of bridges.

MAINTENANCE

The State of Oklahoma, through the Department of Highways, collect a tax on all motor vehicles at the rate of fifty cents per h.p. for the first year, forty cents the second, thirty cents the third, and twenty cents each year thereafter during the life of each vehicle registered, gives a receipt and furnishes a steel tag to each automobile, motorcycle, or traction engine. Ninety per cent. of the money thus collected is returned to the counties from whence it came and ten per cent. goes to the State Treasury and is placed in the general revenue fund, no part being available to the Department of Highways. At this time, $219,912.18 has been remitted to the various counties since July 1, 1915. Of this amount about $156,000 was collected during the 1915 registration and it is estimated that the total amount collected during this calendar year will reach $35,000. This money is to be spent by the various boards of county commissioners, under the direction of the Department of Highways, for the maintenance of completed State roads and for no other purpose.

Notwithstanding the fact that the Olkahoma Highway law has been in effect since June 23, 1915, many persons still inquire of the Department of Highways, "What are you doing with all this money? Why do not you build roads with it? We have never yet seen a road constructed by your department?" Attention is called to the fact that the Department has no part in the expenditure of these funds except to urge and insist that they be expended by the county commissioners in the manner provided by law and our records show that the best results are obtained in this way. The Department of Highways has succeeded in getting a State road system established throughout the State in every county and this is a good beginning at least. Taxpayers and owners of automobiles are urged to assist the Department with their influence and cooperation in securing full benefit from the funds they furnish for the construction and maintenance of roads.

## Oklahoma Highway Department—Instructions and Standards

By Jas. I. Tucker, Professor of Civil Engineering, University of Oklahoma, and Consulting State Engineer, Oklahoma Department of Highways

In the fall of 1915, as soon as the newly organized department of highways had begun to definitely measure its duties, it became clear that definite standards of practice to be observed by the county engineers was of immediate necessity. This was because the county engineers as a class, were widely varying in education and experience, and were sending in their required data in all sorts of degrees of completeness.

To remedy this, a loose-leaf system of Instruction Sheets has been adopted, using the standard "I-P" Cover, No. 505. It is further intended to have all the field notes on State Road work made on the loose-leaf field-note sheets. All this printed material is issued on heavy ledger paper, of exactly the same size, and it is thus possible for the engineer in the field to have designing and reference data and all sorts of information always at hand. Since this plan was adopted, a pamphlet has also been printed, giving the 1915 and 1916 Road Legislation, and through the co-operation of various State Departments, co-operating in road work, a statement of the various duties of all road officials has been added to it. This is also printed in the same page-size, to go into the loose-leaf covers just described, making a very usable and valuable hand-book for the man in the field.

In addition to serving the County Engineers in particular, it was seen that there would be a constantly changing corps of assistants. There was no assurance that even though the engineer was once fully informed, that his assistants would observe his practices. For this reason, Instruction Sheet No. 4 for example, describes in the briefest and simplest way, precisely the method for carrying on transit work in road surveys, including a sample set of transit notes. Since much of the money will go in the drainage structures, it was felt that specific instructions as to the number, position, and precautions required in staking out masonry culverts, wingwalls, and bridge abutments would be useful.

The same remarks apply no less to Staking-out Earth Work, both where substantial quantities of materials are to be moved, as well as taking for bladé-grader work. In the latter case, the tendency was found to be to do more surveying than really necessary. This particular Instruction Sheet concludes with "Shooting-In" grades.

Instruction No. 5 states what is required in a bridge survey, preliminary to beginning bridge plan.

Instruction No. 6 gives in considerable detail a list of what is required to be shown upon bridge plans, all of which are by law required to be submitted to the Department for approval.

Instruction No. 7 consists of specifications for re-inforced concrete work, and is the only specification thus far issued.

The law requires that the State Road System of any County shall be selected by the County Commissioners, with the County Engineer, who submit their selection to the Department for approval.

It was found that few of them at first showed in any consistent way, what was required, hence the first Instruction Sheet goes into considerable detail, covering the preparation of County maps, plats, drawings, or other documents for submission to the Department. The same remarks apply with still more force in regard to the working plans and profiles of the roads themselves. It is the intention of the law to definitely begin to gather accurate and comprehensive data upon each section of State road, beginning with the time when the law went into effect, July, 1915. Hence it will be seen that since the original survey is intended for the basis of all subsequent improvement, that such a plan must be specific, accurate, and comprehensive. Instruction No. 2 covers this.

It is the Department's intention to issue considerable number of these Standard Instructions from time to time, and to embrace in them all sorts of useful work or data for the county engineer, both in the field and office.

The co-operation of other State Highway Departments along this line would be greatly appreciated. It is thought that a dozen or more States working under conditions at all comparable could agree to issue to their engineer instructions on this loose-leaf system in sheets of a standard size, 4¼ by 7¼, with printing in 8-point type. They could then exchange sheets as prepared, and in a comparatively short time produce a most authoritative highway engineer's manual, such as does not now exist, for country road work. The writer has been chiefly responsible for this part of the Department's work thus far, and would gladly receive suggestions or comments from other highway officials, looking to progress in this direction.

### Announcement

Max L. Cunningham, of Oklahoma City, Oklahoma, has been tendered and has accepted the position of State Engineer in connection with the Oklahoma Department of Highways. This appointment is made by George B. Noble, Commissioner of Highways, subject to the approval of Governor Williams. Such approval was given only after the Governor had made a very extensive investigation as to the character, ability, and standing of Mr. Cunningham, the result of such investigation being entirely favorable.

Mr. Cunningham was educated in Lewis Institute, Chicago, and came to Oklahoma in the employ of the M. K. & T. railroad in 1902. He was employed in Oklahoma City as Assistant City Engineer during the period from 1904 to 1906, at which time the Walnut Avenue viaduct and the storm sewers were constructed, this work being planned and supervised by Mr. Cunningham. Afterwards Mr. Cunningham was in the general engineering and contracting business with headquarters in Oklahoma City, and for the past four years has been in the employ of the Benham Engineering Company, of Oklahoma City, during which time he has had an extensive practice in all kinds of municipal work.

Mr. Cunningham is an associate member of the American Society of Civil Engineers. He has the benefit of a wide acquaintance throughout the State of Oklahoma and the work that has been done in this State under his supervision is his recommendation. He will be a valuable addition to the Department of Highways, the engineering work in connection with this Department having been handicapped since the organization on account of the lack of assistance.

W. P. Danford, who was appointed as Assistant State Engineer on July 1, 1915, and has been acting as State Engineer since September 1, 1915, will resume his position as Assistant State Engineer.

With two engineers in this department, a decided improvement may be expected, and from time to time it will be possible for either Mr. Cunningham or Mr. Danford to actively assist in engineering or construction work at various points in the State where they are needed.

* * *

## Bituminous Macadam Resurfaced at Low Cost in Illinois

The Illinois State Highway Department furnished some interesting data and figures covering the cost of applying a high grade asphaltic surface coat. The work was all done under the direct supervision of the Highway Department, and the cost data presented is of an official nature. This explanation is made in view of the fact that frequently when such data is presented, it is made light of, and even efforts made at times to discredit it. Added value is, therefore, given the following data on account of its official nature.

The work in question was done at Oregon, Illinois, on what is known as the Lowden Road. This was originally a bituminous macadam road, the metal having been a soft local stone which was not well suited to the purpose to which it was put, and to the traffic which the road is called upon to carry. The metal varied greatly in thickness, having been from three to ten inches thick. The original bituminous binder was applied by the penetration method, approximately two gallons per square yard having been applied hot. Aztec road binder was used, and, from reports received, gave entire satisfaction.

After several years use however, the soft stone broke up considerably and worked up through the asphalt binder. The road is an important one, and it was decided to have it re-surfaced at once, treating the entire surface with a light application of a high grade asphaltic material and a very hard coarse sand. This meant that 16,222 lineal feet, or 30,906 square yards of roadway surface would have to be treated.

Trinidad B asphalt and torpedo gravel or stone chips were the materials decided upon, and the work was placed under

contract. One-third of a gallon of Trinidad B asphalt and 0.016 tons of torpedo gravel or stone chips per square yard were applied in accordance with the most approved methods for surface treatment.

The average haul for the materials used in the work was one and one-half miles. Teams were paid at the rate of fifty cents per hour and labor was paid at the rate of twenty-five cents per hour, with the usual increase over the latter amount for the foreman in charge of the laborers. A portion of the coat, as will be explained later, was paid by the State Highway Department out of the maintenance fund. The cost data presented herewith does not include any contractor's profit, the materials having been purchased direct by the Department, nor is there any overhead expense of the Department included.

The cost data on this work, as furnished by the Department, is shown in Table No. 1 and the quantities of materials and the unit prices of each are shown in Table No. 2. The itemized costs as given are all per square yard of roadway surface.

| | | |
|---|---|---|
| 1. | Engineering and inspection | $0.0000 |
| 2. | Superintendence | 0.0035 |
| 3. | Trinidad B asphalt, f. o. b. siding | 0.0239 |
| 4. | Torpedo gravel and stone chips, f. o. b. siding | 0.0267* |
| 5. | Hauling torpedo gravel and stone chips | 0.0084 |
| 6. | Heating and applying Trinidad B asphalt, demurrage, etc. | 0.0104 |
| 7. | Spreading torpedo gravel and stone chips | 0.0056 |
| 8. | Sweeping and cleaning the old road | 0.0005 |
| 9. | New equipment (pump) | 0.0007 |
| 10. | Freight on equipment | 0.0015 |
| 11. | Incidental expenses | 0.0022 |
| 12. | Culverts and patching holes | 0.0027 |
| | Total cost | $0.0861 |

*Of this amount, $0.0267, the sum of $0.0012 was paid out of the maintenance fund. The quantities of material used and the prices paid for same were as follows: Trinidad B asphalt, 9,617 gallons @ $0.077 per gallon f. o. b. railroad siding. Torpedo gravel and stone chips, 484 tons of both. Stone was $1.40 per ton and torpedo gravel was $1.82½ per ton, f. o. b. railroad siding.

Surface treatment of macadam roads has made great progress in this country during the past few years, but particularly so in the East, where many hundreds of miles have been and are treated with asphalt, and at prices which are, in some cases, considerably lower than the costs given above. It is a method of preserving the surface of macadam with a waterproof coat and of eliminating the dust that should, and is certain to receive more consideration from road officials in all parts of the country

* * *

## Kentucky

The public purse in Kentucky, as applied to county revenue, is handled by a body of men called the Fiscal Court, which is likewise the Board of Magistrates, the members of which are determined by a popular vote of the electorate in the Magisterial district.

All claims against the county government must be passed upon by the board before they can be paid. Of course the larger per cent. of claims paid by the Fiscal Courts go toward so-called road improvements and it naturally follows that a magistrate elected from a certain district and owing his office only to his constituents in this particular small section of a county, will try to be pretty well assured that his district will get its full share of the county revenue applied to roads, regardless of the relative importance of the location of the roads.

Of course the fault here stated would be practically corrected if each magistrate were chosen by a vote of the entire electorate of the whole county.

However, such is not the case. Kentucky has the Fiscal Courts and the Fiscal Courts have the power to spend the county's finances, and at present Kentucky is consumed with a road building fever. This fever is raging to such an extent that county after county is voting road building bonds in sums ranging from fifty to six hundred thousand dollars. It seems that no great amount of confidence is placed in the ability or desire of the Fiscal Courts to properly and economically spend these large sums for road building. Therefore, in answer to a popular demand, the recent General Assembly passed a law enabling commissioners to be appointed to act in place of the Fiscal Courts in expending the bond issues.

Following is the complete bill: "An act to enable Fiscal Court of any county to select commissioners for the purpose of handling the proceeds of any bond issue voted by the county to build or construct roads and bridges.

"*Be it enacted by the General Assembly of the Commonwealth of Kentucky*":

1. That the Fiscal Court of any county in the Commonwealth may, if it so desires, select or appoint four or more commissioners who shall be freeholders and legal voters and residents of said county, to act as Road Commission in the handling of any funds derived from the sale of bonds authorized and voted for the said county for the purpose of building and reconstructing roads and bridges; and which commissioners shall be equally divided between the dominant political parties of the county. Said commissioners shall be elected at least fifteen days before the date of the election on the question of the bond issue, and their names published in some newspaper of general circulation in the county; and if none by three printed notices posted, one at the court house door and the two others at prominent places in the county.

"2. That in the event that the Fiscal Court of any county does select or appoint commissioners as aforesaid, that their duties in so far as the building and reconstruction and designation of roads to be built with the proceeds of the bond issue shall be identical with those now exercised by the Fiscal Court.

"3. That before entering upon the discharge of their duties, said commissioners shall each give a good and sufficient bond, approved by the County Judge of the county, for the faithful discharge of their duties, and that the said commissioners shall be allowed a reasonable sum for their services by the Fiscal Court, to be paid by the Fiscal Court, but out of the county levy for road and bridge purposes.

"4. That further, Commissioners appointed under this act, shall perform their duties subject to the supervision of the State Road Commissioner, of the State Road Department, should the county so voting bonds take advantage of State aid or receive funds from the State of Kentucky in building public highways.

"5. Emergency clause. And, whereas, there are a number of counties in the State which desire to take advantage of the State aid law, and desire to hold elections under this act, an emergency is declared to exist for the passage of this law, and this law shall take effect upon its passage and approved by the governor."

When a bond issue is proposed it is not infrequent that remarks are heard to the effect that if the Fiscal Court is to spend the money, it should be defeated. But if some good business men are to spend it, the issue should be passed. This is not highly complimentary to Fiscal Courts in general, but it is a fact. It also seems that because the Fiscal Court of Henderson county refused to appoint the Citizens Committee as provided under the above bill, the proposition to vote four hundred thousand dollars in bonds for road purposes was overwhelmingly defeated.

Scott county, for instance, voted one hundred thousand dollars last fall before the passage of the above bill by the General Assembly, however, in the original discussions of the proposition the prominent citizens assured the Fiscal Court that unless a citizens committee of five members was appointed to act with a Fiscal Court committee of four members they would see that the bond issue failed.

Fayette, Kenton, Christian, and other counties carried issues by this means, where doubtless they would have failed if the money was to have been spent by the Fiscal Courts alone.

* * *

No co-operation can be more beneficial than for engineers and officials to be honest and frank with manufacturers and their representatives, and for engineers and officials to come to conclusions in the earliest stage of the contemplated improvement, and make publicly known just what materials will be required to make the improvement. In this way hundreds of thousands of dollars can be saved to manufacturers and great sums to the tax-payers.

# Economical Methods in the Repair of Waterbound Roads

By John F. Gallier, County Surveyor of Wood County, Ohio

THE following article is a rather detailed abstract of an excellent paper prepared and presented at the March meeting of the Northwestern Ohio County Surveyors' Association at Toledo. Wood County has a large mileage of excellently built and excellently maintained water-bound macadam roads, much of the credit for which is due to Mr. Gallier, who is considered an authority on roads of this type. The paper is of unusual interest in view of the fact that a larger mileage of water-bound roads is being built this summer than ever before, and that the total mileage in all parts of the country has now become so great that the best and most approved methods must be used in repairing and maintaining them in an economical manner, as there is no doubt but that the water-bound road can be built and kept in first-class condition in thousands of localities where an expensive type of pavement is impossible on account of the much higher cost of construction.

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The above title, probably, is the largest question which confronts the County Highway Superintendents of Northwestern Ohio, and it would be impossible to go into all phases of the question in a brief article. Therefore, my aim will be to briefly enumerate a few of the fundamental principles and to recount some personal experience along this line, in order that my co-workers can go deeper into the subject through a general discussion and future thought and consideration.

Macadam, as a paving material, has been more generally used than any other material, and I might truthfully add, more universally abused. There is not, in my mind, any doubt but that water-bound macadam has been given the least thought, the most abuse, and has been the least understood of any class of paving material now in use.

We build brick, concrete, and bituminous roads, but before doing so we carry samples of these materials to our laboratories and make such fine tests that it is necessary to use the French system to record our results. But how many of us have ever stopped to study the composition of our macadam material? Could you tell whether it would make better lime than road material? Can we always distinguish between silica and clay in screenings? Have we piled this material, ranging in size from dust to six inch cubes on the road and taken no thought of its composition? Have we always considered that a macadam road should have as good drainage as a concrete road?

It is because of these things that the maintenance of each macadam road presents a problem within itself; and too many of us have thought that water-bound maintenance was like a problem in mechanics which could be solved by some well known formula.

A visit to each road which is to be repaired is necessary, and a few of the fundamentals which must be determined before proceeding with the actual work of repair are as follows:

1. When, how, and by whom was the road originally constructed?
2. Has it ever been repaired?
3. Determine the quantity and quality of the metal now on the road.
4. Where was this metal obtained?
5. How was it crushed or broken?
6. Is the drainage complete?
7. What kind of traffic uses the road?

And do not fail to take into consideration the time of the year when the repairs on this particular road are to be made. This latter statement is not predicated on the phases of the moon, yet its observance has saved Wood County, Ohio, thousands of dollars. We contend that the method of repair on water-bound roads varies with the season in which such repairs are made.

Maintenance in the spring should begin as soon as the frost has left the macadam. All mud should be scraped from the road surface, after which the earth berms should be trimmed down and the macadam surface rolled with a ten ton roller. It is important that all of this should be done before the road has had a chance to thoroughly dry out, and if these instructions are carried out, wonderful results can be obtained without the addition of any new material whatever. The spring maintenance should be confined to the roads which you cannot afford to re-top. The holes and ruts on these roads should be cleaned out and all mud and foreign matter removed. They should then be filled with number two, three, or four stone, as the occasion and the particular road may require. This stone should all be properly screened and free from dirt and small stone. It is not always necessary or economical to roll these patches after such work has been completed, but it is absolutely essential that the quality and the size of the stone be right. If the holes are deep, use number two stone in the bottom, number four stone on top, and finish with screenings. If the houles are not deep, use number four stone and cover with number seven stone or screenings.

Interest your township trustees and township highway superintendents in this work, for you must always bear in mind that it will be impossible for you, or any other one man, to look after all of this work alone. If you are situated like the writer, with nine hundred miles of macadam roads, you would soon see how impossible this would be. You must have local co-operation, and lots of it, and if you succeed in getting it, you will soon find that community pride and community interest will relieve you of a lot of work and worry. Spring work, if conducted in this manner, will bring good results at a minimum cost.

### SUMMER MAINTENANCE AND REPAIR

Summer maintenance and repair, however, is quite a different story. By this time much of our co-operative assistance has now gone to work on the farm and our roads have now become dry and firm. Motor travel now harasses us in our work, and material left loose on the road is soon thrown over into our fields.

The equipment for macadam road repair should now be composed of a ten ton, three wheel road roller, a sacrifier, a road scraper or grader, a sprinkling wagon, and a gasoline engine and pump for pumping water. If the road to be repaired has plenty of metal in it, and, this metal in the surface is not too coarse it should be well dug up with the scarifier, and then leveled off with the road grader and re-water-bound. In this latter operation, new screenings, should always be used. I have known roads of the water-bound macadam type to be kept in excellent condition by using these methods at a cost of but thirty dollars per year.

In repairing an old road the macadam should not be broken down to the subgrade, and if there are only three or four inches of old metal on the road it should not be loosened up. The better method of repair would be to clean the surface of all dirt and dust, after which a four-inch water-bound top should be added.

Where it is determined in road maintenance that it is necessary to add new metal for an entirely new surface, it is, of course, the new material which costs the most. Therefore, we must be conservative along this line.

### FALL MAINTENANCE

Fall maintenance should be combination of both the spring and summer methods, the particular conditions found on each road governing how this combination shall be effected. The work should be pushed vigorously, as now the roads are to be placed in condition to undergo in the best way, their greatest trial—winter freezing and thawing—which sometimes blasts all our theories of maintenance.

Last November I wanted to repair the road leading east from Grand Rapids toward Bowling Green, a distance of about ten miles. This water-bound macadam road was built twelve feet in width about twelve years ago. About six years ago some repairs were made on this particular road, but none have been made since that time. The surface had become so rutted and pitted that it was dangerous to drive an automobile over its surface at a rate of even ten miles per hour. I saw, after a thorough inspection of the road, that it must be repaired before winter set in, and during a conference with our County Commissioners I told them that one cubic yard of stone placed on this highway at that time would save two cubic yards if it

were not placed until this summer. Very fortunately, the County Commissioners agreed with me, and we determined to save the road and place it in good shape for the winter.

It happened that just at this time all of the macadam road rollers owned by the County were busy in other locatities finishing up work, and that all of the contractors in our vicinity were using their rollers with the same object in view. We therefore, did the only thing that it was possible for us to do if we were to fix up that road before winter.

We employed at a rate of twenty-five dollars per day a steam hauling outfit which consisted of a twelve ton traction engine and four nine-yard trailer wagons, all of the latter equipped with twelve-inch steel tires. We shipped number four and number seven stone (mixed) to a point about the center of the road that was to be repaired. The freight rate was twenty cents per ton and the cost of unloading with a Galion Unloader, manufactured by the Galion Iron Works & Manufacturing Company, Galion, Ohio, was about eight cents per ton. The stone was loaded directly from the hopper into the nine-yard cars and then hauled to the road, where spreading was commenced at the nearest point on the road to the point where the stone was unloaded from the hopper. Each succeeding load was drawn over the stone that had already been spread on the road. After a few loads had been dumped on the road, an engine hitch was used so that the trailers carrying the stone would not track. A road grader for leveling the stone was used behind the trailers when they were dumping the stone on the road.

With the exception of the last few loads of stone on the ends of this road, the hauling, spreading, and rolling was completed in one operation, which proved to be a most economical method of handling this particular proposition under the circumstances. One thousand eight hundred tons of stone were used, the delivered price at the point of unloading being eigthy cents per ton. The cost of unloading, hauling, spreading, and rolling with the steam traction outfit and trailers was less than sixty-five cents per ton. The average haul was 2.75 miles. The cost of putting the road in first class condition was a little less than $240 per mile. I was over this road in March of this year, and it was in fine condition for summer travel, and will hardly need much more, if any attention, this year.

I might recount several other similar cases where unusual conditions were encountered and met, but I believe I can assist you more if I urge you to particularly study each road maintenance case in detail before any money is spent in making any improvement. After this is done, the method of proceeding should be determined upon and work started.

The life of a macadam road depends upon its maintenance, and maintenance consists of draining and in keeping and preserving a smooth and hard surface for travel. Roads of this type will rut and pit under traffic if they are given a chance, and the only way to remedy them after they have reached this stage is to fill such places with stone or to eliminate these ruts and pits by proper rolling. The secret of the success of the water-bound macadam road, however, is to properly maintain it, and to make the repairs before the ruts and pits become too large or before they extend too far.

* * *

## Aggregates, Mixing Plants and Expansion Joints for Cement-Concrete Pavements

APPROXIMATELY 15,000,000 square yards or the equivalent of 1,600 miles of sixteen foot road were constructed in the past year of Portland Cement Concrete. This fact in itself is sufficient evidence of the increasing popularity and approval by the public of this type of paving material. This also subtantiates the claim that the concrete road is long past the experimental stage, and as indications point to an ever increasing yardage each year it is highly gratifying to note that the courses in Highway Engineering in our Universities and Engineering Schools are recognizing this fact, and endeavoring to keep their students informed of the modern developments and most recent practices in Highway Construction.

I will discuss the subjects of my title in order and at the conclusion of the paper will endeavor to answer any questions pertaining to the construction of cement concrete pavements as it is effected by the aggregates, equipment, or joints.

Aggregates are first in order as well as in importance in the title. The proper selection of aggregates is fundamental in all good concrete and the motto that " a chain is no stronger than its weakest link" is applicable to concrete in this connection. Realizing the importance of the aggregates in concrete construction the necessity of careful selection and discrimination must be obvious in determining what aggregates shall be allowed in cement concrete pavements. In road building the concrete is subject not only to compression and tension, but also has to withstand abrasion and impact to such a degree that it places this type of concrete structure in a class by itself. It is evident then, that, inasmuch as the abrasive quality of the concrete is directly influenced by its component parts, these parts must be as near perfect for performing their functions as is consistent with economy. Therefore, it devolves upon us to determine what the requisites for good aggregates are and how they shall be determined.

### FINE AGGREGATE

In the past too little consideration has been given to the importance of the fine aggregate in concrete. The permeability of the concrete and its bonding qualities with steel reinforcement are directly influenced by the nature of the fine aggregate. The strength of concrete is dependent upon the strength of the mortar holding the course aggregate in place, which in turn depends for its strength upon the cementing value of the sand-cement mortar.

To insure the cementing quality of the cement we have pages written on specifications by the United States Government. The American Society for Testing Materials and the American Society of Civil Engineers defining in exact terms the standards which must be met. Although the fine aggregate is a much more non-uniform and variable product, the specifications for sand are generally covered in a few lines in spite of the fact that there is twice as much of it used in concrete as there is cement.

In a study of 184 specifications for concrete roads and pavements from all parts of the country within the last two years only fifty-seven per cent. covered the specifications for sand in over fifty words, thirty per cent. used between twenty and fifty words and thirteen per cent. required less than twenty words to cover this important essential.

### TABLE ONE—SAND SPECIFICATIONS

RESUME OF FINE AGGREGATE CLAUSE IN ONE HUNDRED AND EIGHTY FOUR SPECIFICATIONS FOR CONCRETE ROADS

**184 SPECIFICATIONS FOR CONCRETE ROADS AND PAVEMENTS.**

| | |
|---|---|
| 166 or 90% | specified that the fine aggregate be clean. |
| 90 or 49% | specified the allowable percentage of loam. |
| 79 or 43% | specified gradation tests by sieve analysis. |
| 69 or 37% | specified that the fine aggregate be sharp. |
| 60 or 32% | specified that briquettes be tested for tensile strength. |
| 43 or 23% | specified that the fine aggregate be coarse. |
| 43 or 23% | specified that the fine aggregate may be stone screenings. |
| 8 or 4% | specified that the fine aggregate be washed. |
| 5 or 3% | specified the maximum precentage of voids. |
| 2 or 1% | specified a minimum weight per cubic foot. |
| About 75% | eliminated frost or frozen material. |
| One specification | contained no requirements for fine aggregate. |

My object in showing this table is to demonstrate the inadequacy of most specifications to properly treat the subject of fine aggregates. We see here that more than fifty per cent. have omitted one or more of the important requisites, with the exception of cleanliness, and this brings out very clearly the necessity of standardizing sand specifications.

Let us enumerate the items shown on the table and briefly discuss their relative values; ninety per cent. require that the fine aggregate be clean so that the necessity of cleanliness in materials seems to be pretty generally recognized, but the question immediately arises as to what is meant by cleanliness. It is evident that opinions vary on this subject—cleanliness is subject to many interpretations and is such an important essential in concrete that it should be qualified by more definite terms. I was disappointed to see that approximately twenty-five per cent. had neglected to reject frost or frozen materials, but trust that this may be partly explained by the time limits in the specifications or the location of the work precluding the possibility of this occurrance.

Now we come to the points which over half failed to specify —some of which are essential and some possibly detrimental. Forty-nine per cent. stated the maximum percentage of loam

Lecture delivered by Lewis R. Ferguson, Chief, Engineering Department, Portland Cement Association, Chicago, Illinois, in the Graduate Course in Highway Engineering at Columbia University, on February 18, 1916.

allowed. For the reasons stated above this clause should have occurred in all, it states in tangible terms just how clean the fine aggregate must be. Only forty-three per cent. required a sieve analysis to determine the gradation which, as I shall show later, is very important, yet nearly the same number—thirty-seven per cent. required that the sand be sharp. This is one of the points, and we see that it is quite common—which might result in an injustice. I can imagine a sand which would pass all the other requirements of a specification and yet not have a sharp edge or corner in it. This quality in the sand, which seems so desirable to many, is probably founded on the principle that angular grains will make a more compact mass and by interlocking will perhaps increase their strength in compression. Such action, however, is insignificient as compared with the resistance of the sand grain to displacement as determined by the amount of adhesion between the surface of the sand grain and the cement. Experiments have shown that we can disregard the shape of the grain but that the condition of the surface is important in determining the amount of adhesion or bond obtainable.

In a test covering thirty-one samples of Illinois sand conducted by C. C. Wiley, of the University of Illinois, only five of the natural sands gave a tensile strength greater than the Ottawa natural sand, and each of these five was a bank sand with rounded grains, which would not be considered as "sharp."

Thirty-two per cent. required that a sand cement mortar be made and that the briquette be tested for tensile strength. Although this test gives a very good idea of the value of a sand, why it is not more rational to test the mortar or sand in compression, since by this means there is obtained a relative value of the sand for the purpose for which concrete by itself is especially adapted, that is to withstand compression rather than tension. Twenty-three per cent. specified that the sand be coarse. Experience has demonstrated both practically and experimentally that coarse sands will make a denser mortar than fine sands, but this term is also qualitative and the idea can be better expressed by a gradation or sieve analysis requirement. This must be somewhat flexible in order not to discriminate against sands which will give very good results but which are not especially well graded and which may not have the coarse particles predominant.

Twenty-three per cent. allowed the use of stone screenings on which I will say more later on, and in addition we have the very few specifying that the sand be washed, probably local sand known to be dirty; the maximum percentage of voids, which might well be included as an additional test or check on gradation; and a minimum weight per cubic foot, which, I believe, wholly superfluous in a specification because of the variable in compactness and moisture content.

From this resume of our table let us ascertain what are the important essentials to be specified and why, bearing in mind, the purpose of our material specifications, that is, to advise the prospective bidder what is expected of him to ensure the success of the work.

1. The mineralogical composition of the fine aggregate is important. The sand-cement mortar, in addition to its function of cementing the coarse aggregate in position, has to withstand its share of abrasion and impact so that the fine aggregate must be the natural or mechanical segregation of the finer particles of hard, tough, and durable stone. In this connection the question arises as to which is preferable—the natural or mechanical segregation—in other words, natural sand or stone screenings. Although labratory tests have shown excellent results with stone screenings, actual practice does not seem to bear them out.

(Slide 43-1234; Table 2, New York. Self explanatory—Compressive strengths of 1-1½-3 concrete using stone and sand 3520, gravel and sand 3105, and stone and screenings 2250. Cubes made in the field and stoned for twenty-one days. Total of 424 inches.)

(Slide 43-1232; Table 7, New York. Self explanatory—Comparative tests on 1-2½-5 concrete using different aggregates.)

It is extremely difficult to get a proper gradation of stone screenings and there is practically always present a very large proportion of material that is too fine—much of it being dust which is just so much inert material. Nevertheless, the strength of concrete with some sands could undoubtedly be materially increased by the inclusion of a certain percentage of stone screenings. Natural sands should be largely composed of quartzite grains or other equally hard material, and the grains should present a rough unpolished surface to which the cement will readily adhere.

2. The fine aggregate should be well graded. This makes for a dense concrete insuring impermeability, better adhesion to reinforcement and greater strength.

(Slide 43-1237; Table 5, New York. Effect of sand gradation on the compressive strength of concrete.)

Sand No. 1, which has a fairly uniform gradation and a larger proportion retained on the No. 50 sieve with very little fine material tests 157.5 per cent. of Ottawa in compression; while Sand No. 2, with a comparatively small amount retained on the No. 50 sieve and a large proportion passing the No. 100, over half of which passed the No. 200 sieve tests only to 44.2 per cent. of Ottawa in compression and is not suitable for use in concrete.

(Slide 43-1233; Table 6, New York. Effect of sand gradation on the compressive strength of concrete).

Shows the effect of coarse and fine sand. The first sand fairly well graded but with considerable fine matter and 34.5 per cent. voids showed 108.5 per cent. of Ottawa in compression in 1.3 mortar. The second sand composed almost entirely of coarse particles and with a smaller percentage of voids (the loam content being practically the same in each) tests 128.4 per cent. of Ottawa, or an increase of 17.4 per cent. over the first sand. It is also interesting to note here the practical significance of these compression tests of mortar, as shown in actual field conditions with the concrete. The sands give 1-1½-3 concrete of 3320 and 3670 pounds per square inch, respectively, in compressive strength. The concrete composed of the second sand which showed to be 17.4 per cent. stronger in mortar compression, tests 10.5 per cent. stronger than the concrete composed of the first sand, and if the tests had been conducted for the same length of time the per cent. increase in the strength of the concrete would have more nearly approached 17.4 the per cent. increase in the strength of the mortar. In order to secure a sufficient amount of coarse particles and not too much fine material, we should specify that the fine aggregate should all pass a screen having four meshes per linear inch, not over twenty-five per cent. should pass a sieve having fifty meshes per linear inch, and not more than five per cent. pass a sieve having 100 meshes per linear inch.

3. Fine aggregate must be clean, and, as previously illustrated, this fact seems to be well recognized. The statement that it shall be clean, however, is merely qualitative and allows various interpretations. This is very important and should be specified so that the degree of cleanliness can be ascertained. This should be done by stating that not over three per cent. of clay or loam shall be allowed.

(Slide 43-1014. Showing sand pit well stripped.)

In sand pits the material can be kept clean only by keeping the loam, roots, and vegetable matter stripped well back from the face of the pit.

4. Although the fine aggregate may have the proper mineralogical composition, be well graded with coarse particles predominant, and be proved to be clean according to the specifications, we still desire to know just how it is going to act with the cement, and to ascertain this we must mix a representative sample and compare this mortar with Ottawa sand, which has been designated as the standard of comparison.

We have seen that a number of specifications have required this, making the comparison with Ottawa for tensile strength—determined by breaking a briquette held in tension.

The test for tensile strength has undoubtedly been more popular on account of testing cement this way and because the machine is smaller and more easily operated. We are, however, more concerned with the strength of the concrete in comparison and should therefore test our sand in comparison with cement. If a road cracks because of insufficient tensile strength in the concrete it can be repaired. If it fails because of its inability to withstand the compressive stresses to which it is subjected it is a failure. Furthermore, to withstand tension we introduce steel reinforcement so that it seems much more logical to test our materials in the concrete for the purpose for which they are primarily adopted, that is compression. Another argument in favor of compressive tests is that we can readily follow up the compression tests on the sand-cement mortar with

compression tests on the concrete cubes under actual field conditions, thereby substantiating our opinions formed from the preliminary tests as demonstrated by one of the slides previously shown.

## TABLE TWO—STONE SPECIFICATIONS

RESUME OF COARSE AGGREGATE CLAUSE IN ONE HUNDRED AND EIGHTY-FOUR SPECIFICATIONS FOR CONCRETE ROADS.

184 SPECIFICATIONS FOR CONCRETE ROADS AND PAVEMENTS.

162 or 88% specified that the coarse aggregate be clean.
153 or 83% specified the minimum and maximum size.
64 or 35% excluded flat or elongated particles.
18 or 10% specified certain percentage pass certain sized screens.
3 or 2% used the clause "No intermediate sizes shall be removed."
8 or 4% allowed the use of crusher run stone.
3 or 2% did not permit the use of crusher run stone.
3 or 2% specified the maximum percentage of voids.
6 or 3% required a specific gravity of 2.6.
5 or 3% required an abrasion test.

### COARSE AGGREGATE

The matter of coarse aggregate is not quite so complex, their function in concrete is different and because of their larger size and greater unformity, we are able to pass judgment more readily upon their acceptibility. There are, however, certain qualifications more essential in the coarse aggregate for paving purposes than for the usual type of concrete and before entering into these I am going to ask you to bear with me while we briefly observe the diversity shown in the requirements for coarse aggregate in this table, which has been compiled from the same specifications as previously illustrated.

Although there is greater uniformity shown here than in the specifications for fine aggregate as shown by the large percentages specifying cleanness, and size, we see that many have missed other important essentials such as the use of bank run gravel and a test for abrasion and even note some differences of opinion over the matter of crusher run stone. I do not believe it necessary to discuss the various qualifications as shown on this table further, so will at once take up the essential requisites for coarse aggregate for concrete road work.

1. The coarse aggregate must be clean. If the stone is coated with any foreign matter a good bond with the mortar cannot be obtained and for the same reasons as mentioned heretofore the term "clean" should be strengthened by excluding all vegetable or other deleterious matter.

2. The mineralogical composition of the stone is probably the next most important consideration, if not *the* most important, as upon this depends the abrasive quality of the stone, which in turn directly effects the durability of the pavement. The importance of this is evident, inasmuch as the coarse aggregate has to withstand practically all the wear and impact upon a road, and you must all realize that none but the best stone available should be used for this purpose. To obtain this we should specify that the coarse aggregate consists of hard, tough, durable crushed rock or pebbles, and as an aid in determining whether or not the coarse aggregate will be satisfactory, its abrasive qualities should be determined by testing for the French coefficient of wear. The minimum value assigned to this should be at least ten and where practical a minimum French coefficient of twelve would be advisable.

3. (Slide 43-1016. Showing flat stones in surface of pavement.)

The coarse aggregate should contain no soft, flat, or elongated particles. The necessity for this provision is illustrated by the view on the screen. We see here flat or laminated particles of stone floated on the surface, which, of necessity, have a poor bond in the concrete. These will soon be chipped out and form a depression, which under steel tired traffic will in time become a hole unless the defect is repaired by covering with bitumen.

4. (Slide 43-1663. Crushed stone.)
(Slide 43-967. Pebbles.)
(Slide 43-1408. Crushed stone.)
(Slide 43-995. Two sizes of coarse aggregate.)

These views illustrate the proper size and gradation of the coarse aggregate. The maximum size should be such as will pass a one and one-half inch round opening and should range from one and one-half inch down not more than five per cent. passing a screen having four meshes per linear inch, and no intermediate sizes should be removed. This will give a concrete of the greatest density and compactness. The road depends upon the coarse aggregate to ultimately take the wear and these stones should be placed as close together as practicable with a minimum amount of voids, then instead of depending upon nature to hold them in place, we bind them securely together with the most durable and tenacious binder known to modern science; that is, Portland Cement.

In connection with the advisability of using pebbles or crushed stone, and you will note that I avoid the use of the word "gravel" in this connection, which is ambiguous and misleading, I would say that excellent results have been obtained with both, although the crushed stone is preferable for two reasons. Broken stone with their comparatively rough surface offers great adhesion to the mortar so that a better bond is secured than with pebbles. It has furthermore been noted that crushed stone concrete is less susceptible to cracking, probably due to a smaller coefficient of expansion and contraction. This was demonstrated on the experimental concrete road built by the United States Office of Public Road in 1912 at Chevy Chase, Maryland, where the average distance between transverse cracks varies from 45 feet in sections where pebbles were used to 145 feet where crushed limestone constituted the coarse aggregate. The only advantage in the use of pebbles, outside of economy, is that pebble concrete will more readily conform to the desired surface under the template and will not require as much floating.

An important precaution in the specifications for aggregates, is to exclude the use of crusher-run stone, bank-run gravel, or artifically prepared mixtures of fine and coarse aggregate. Such mixtures cannot run uniform and it would be impossible to obtain a concrete of uniform proportions or consistency by allowing the use of such material.

Before leaving the subject of aggregates I wish to discuss a few points concerning both fine and coarse aggregates.

1. It is obvious that if these requirements for aggregates are to be enforced it will be necessary for the engineer to have a representative sample of the aggregate for testing. This not only protects the engineer but also the contractor or prospective bidder; who shall furnish the sample before buying his materials. It should further be stipulated that if the sample be found to pass the requirements of the specifications similar material shall be considered as acceptible for the work and that all aggregates used shall meet with the approval of the engineer and shall fulfill the requirement of the specifications. The person submitting the sample would then, for his own benefit, select a representative sample which should weigh approximately fifty pounds.

(Slide 43-1237. Table 5, New York. Shown before.)

To illustrate the necessity of carefully selecting the sample by taking material from different parts of the deposits and quartering them, the slide shown is interesting. You will note the great difference between sands No. 1 and No. 2, yet these tests are on sand taken from the same bank at two different times by two different engineers.

In no case shall aggregates containing frost or lumps of frozen material be used. The necessity of this is so apparent that I will not enlarge upon it. We have seen the advisability of accepting only aggregates that are clean, but to ensure that they are kept clean a clause should be inserted to the effect that care should be observed in the handling of materials to see that no dirt, pieces of wood, or other deleterious matter be included with them in the concrete.

### MIXING PLANTS

As a general rule aggregates are piled on the subgrade of the road which has been previously prepared and thence conveyed by wheel barrow to a concrete paving mixer. There are two general types of mixers in use for this purpose, differing essentially in the method of discharge. We are not immediately concerned with the mechanical structure of the machine, except as it may decrease the cost of construction, but are interested in the product of the machine so must give consideration to the parts of the equipment directly affecting this product.

(Slide 43-1541. Koehring road work.)
Slide 43-1098. Koehring paving.)

Practically all of the better types of mixers depend upon a revolving cube, drum, or truncated cone, with or without blades to thoroughly mix the ingredients of the concrete. Having mixed them we desire to convey them with as little rehandling as practicable to the road bed. These views show one method of accomplishing this. The concrete is discharged into

a bucket conveyor which travels on a swinging boom, operated from the mixer. This machine conveys the concrete without appreciably disturbing the component parts in a rapid and efficient manner and is well liked by contractors due to the facility for placing the concrete at any desired point on the road. Possible disadvantages are that the bucket will not hold a full batch and two trips of the bucket are necessary to empty the drum; some of the cement mortar is frequently lost in conveying, either through leakage or the overfilling of the bucket; and it generally requires at least two men on the machine, one operator and one fireman. and I have known three to be used.

(Slide 43-756. Chute mixer.)

(Slide 43-980. Chute mixer.)

In these types of chute mixers the methods of loading and mixing are similar to the boom and bucket type, but we see a new method of discharging or conveying the concrete to the road bed. Although this type probably deposits the concrete more rapidly than the previous type and may permit faster work, by this I do not mean faster mixing, it has one serious objection. The slope of the chute is not steep enough to allow concrete of the proper consistency for road work to flow into position. This means that a laborer must assist it down the chute with a hoe or shovel, and as the contractor is reluctant to undergo this additional expense he usually attempts to mix the concrete so that it will flow more readily, and this gives a concrete much too wet for paving purposes.

(Slide 43-1136. Chicago mixer—Revolving chute.)

This shows another method of depositing—that of conveying the concrete through a revolving chute. This type has three disadvantages. The process of conveying in the chute is not one of mixing, but many are inclined to regard it as such and consequently decrease the time the materials are held in the drum. A sufficient time of mixing is of the utmost importance, each batch should be given at least a minute and preferably a minute and a half in the drum. Forty seconds in the mixer and ten seconds in the chute are not sufficient. The machine also deposits the concrete only at the end of the chute. This is extremely unhandy, especially in the case of reinforced pavements, and this fact also necessitates considerable shoveling to reach other points in the road not accessible to the arc formed by the end of the swinging chute.

(Slide 45-50, Smith Chicago Paver—Skip.)

This shows a new type of paver just placed on the market, and built especially for concrete roads. It has many improvements which we believe will be to the advantage not only of the concrete road, but also to the builder and eventually to the taxpayer. We note first the extreme width of the skip allowing three wheel barrows to be dumped at the same time in the larger sizes.

(Slide 45-56, Smith Chicago Paver—Complete.)

This view shows the high drum with a steep angle of flow —twenty degrees with the horizontal. The chute is deep and semi-circular so that the aggregates may slide down without any segregation when of the proper consistency. I would also call your attention to the intermediate openings and auxiliary chute. We also note here the one man control—all operating levers, gauges, injectors, lubricators, and the fire box door being on the same side. In connection with the fire box I was advised that this mixer had been operated on one wheel barrow of coal for ten hours, although my informant advised me that the coal was of an extra grade. I thought to myself that the wheel barrow must have been of an extra grade also, but made no comment. The discharge chute cannot perform its function while the skip is in the air—this precludes the possibility of continuous mixing. Probably the most novel feature is the water measuring or water weighing device. A storage tank varying in capacity from fifty to 125 gallons automatically fills the tipping tank with the desired amount, which is regulated by sliding the weight along the balance arm. As the skip is raised it operates a bell crank and lever which dumps the tilting tank into the lower one, from which the water flows into the drum.

(Slide 45-49, Smith Chicago Paver—Mixing.)

This shows the water entering the drum and wetting the aggregates as they are introduced—the water entering the drum just ahead of the batch and flowing in along with the batch. We also note the thorough mixing in the centre of the drum and how a rapid discharge is obtained by the slope and by the fact that the discharge chute enters two-thirds of the way into the drum.

(Slide 43-1412, South Bend to New Carlisle, Indiana. Shows car dumping into mixer with side skip.)

This illustrates another method of handling the materials and mixing the concrete. The aggregates are first proportioned and are then hauled from the central storage plant on an industrial track and dumped into the mixer. Each car contains a complete batch. By this means the aggregates are kept clean and there is practically no finished grading to be done caused by material wagons cutting up the subgrade.

Another method occasionally resorted to is to have a central mixing plant—or a plant moved ever so often—and conveying the concrete by horse-drawn buggies or by concrete carts or wheel barrows. None of these methods are to be favored, as this rehandling not only causes a segregation of the aggregates, but also a loss of the mortar and if prolonged, a partial hardening of the cement.

(Slide 43-1520, Cement Storage—Allentown—Easton.)

Although perhaps not directly included under this heading, cement employed by the Pennsylvania State Highway Department on the Allentown-Easton road as a solution of this problem in road work. Here the cement is thoroughly protected and always on hand with a minimum amount of handling and at a minimum cost.

### JOINTS

The joint question in the construction of concrete pavement has caused considerable discussion as regards spacing, thickness, type, and construction. The results obtained from a study of 215 specifications written in the last two years show that there are many conflicting views on these points. I have had tables prepared giving the tabulation of these specifications and am showing them here, as I believe they are interesting in demonstrating that in spite of the great diversity of opinion, we can let the majority rule in each case in determining upon our standard and find that this will conform very closely to recommend practice. Of these specifications 138 were for one-course and seventy-four for two-course work, three covered both; 159 were city specification (not all necessarily pavements) and forty-eight were State, county, or highway specifications, and eight were miscellaneous, as a rule covering both pavement and highway. Eighty of these specifications were for reinforced work.

### TABLE 3. SPACING OF JOINTS

SPACING OF JOINTS IN TWO HUNDRED AND FIFTEEN SPECIFICATIONS FOR CONCRETE ROADS

**215 SPECIFICATIONS FOR CONCRETE ROADS AND PAVEMENTS.**

| | |
|---|---|
| 5 or 2% | specified that joints be placed every 20 feet. |
| 55 or 26% | specified that joints be placed every 25 feet. |
| 58 or 27% | specified that joints be placed every 30 feet. |
| 24 or 11% | specified that joints be placed every 35 feet. |
| 27 or 12% | specified intermediate distances mostly between 25 and 35 feet. |
| 6 or 3% | specified that joints be placed every 40 feet. |
| 11 or 5% | specified that joints be placed every 50 feet. |
| 30 or 14% | had no joints specified. |

From this table we see that about seventy-five per cent. specified that the interval between transverse joints be between twenty-five feet and thirty-five feet, and that thirty feet was the distance most often designated. Experience has shown that a concrete road built without joints or reinforcement will crack transversely on an average every thirty to thirty-five feet so that it seems necessary to provide against this by placing the joints at approximately this interval.

(Slide 43-1542. View showing joints in road.)

### TABLE 4.

THICKNESS OF FILLER IN TWO HUNDRED AND FIFTEEN SPECIFICATIONS FOR CONCRETE ROADS

**215 SPECIFICATIONS FOR CONCRETE ROADS.**

| | |
|---|---|
| 15 or 7% | specified the joint filler have a thickness of ⅛ inch. |
| 65 or 30% | specified the joint filler have a thickness of ¼ inch. |
| 36 or 16% | specified the joint filler have a thickness of ⅜ inch. |
| 30 or 14% | specified the joint filler have a thickness of ½ inch. |
| 9 or 4% | specified the joint filler have a thickness of ¾ inch. |
| 6 or 3% | specified that joint filler have a thickness of one inch. |
| 8 or 4% | used expressions such as "shown on plans," "satisfactory to engineer," etc. |
| 46 or 21% | specified no thickness. |

Although twenty-one per cent. require no special thickness of filler, by far the greatest number called for a joint one-fourth inch thick and experience has shown that a width of one-fourth inch to three-eighths inch is most suitable. A filler one-eighth inch thick would probably provide for expansion

and contraction if it could be properly constructed, but such a thin sheet is very pliable and easily worked out of position during construction. Not only does a wide joint increase the cost, but also tends to increase the wear at the joint, which is a thing that should be avoided as much as possible.

(Slide 43-282. Joint in road.)

TABLE 5.

TYPE OF JOINTS IN TWO HUNDRED AND FIFTEEN SPECIFICATIONS FOR CONCRETE ROADS

**215 SPECIFICATIONS FOR CONCRETE ROADS AND PAVEMENTS.**

34 or 15% specified poured joints of bitumen.
31 or 14% specified a bituminous filler.
31 or 37% specified a bituminous filler with fibre matrix.
22 or 10% specified a tar paper filler.
3 or 1% specified a wooden joint.
40 or 18% specified no special type.
4 or 2% specified some other kind of treatment.
101 or 47% specified steel protection plates at the joint.

Here eighteen per cent. specified no type of joint but thirty-seven per cent. required a premolded filler of bitumen with a fibre matrix, next in popularity was the bituminous or tar paper filler, designated by twenty-four per cent. Fifteen per cent. specified a poured joint.

(Slide 43-245. Poured joint.)

This latter should not be given further consideration. It is more expensive—more troublesome to install—and the results obtained not as satisfactory. In addition there is always present the danger of weakening the concrete in the process of pulling out the steel or wooden strip used in constructing this type of joint. By far the best results have been obtained with the premolded joint containing a fibre matrix. This type can be more correctly and easily installed—it is stiff enough to hold its shape and if left protruding will protect the edges of the joint, when steel plates are not used, for an appreciable length of time. A new joint filler of a light color and made so that it would not become too brittle in cold weather and yet not have a high melting point, so as not to soften too much in hot weather, would undoubtedly find a ready market in the highway field.

(Slide 43-723. Protected joint in road.)

Regarding the type of joint we find that forty-seven per cent. require that the edges of the joint be protected with soft steel plates. This view shows such a joint which has been in service for three years and is evidently giving excellent satisfaction. There is no doubt that such a joint when properly installed is well worth while, for it eliminates the wear at the joints and requires no further maintenance.

(Slide 43-1512. Kahn joint with installing device.)

One of the companies furnishes this device to aid in properly installing the joint which facilitates matters considerably—but great care must be exercised to see that the surface of the steel plates conforms to the surface of the road. If the plate is high it is a menace to traffic unless chiseled down, if set low it will not perform the function for which it was intended, at least not for a good many years.

In deciding whether or not to use steel plates, which will add from four to five cents per square yard to the initial cost, the amount and kind of traffic should be considered, also the facts as to whether or not they will be correctly installed, and whether or not if left unprotected they will be watched and repaired or maintained when necessary.

TABLE 6.

CONSTRUCTION OF JOINTS IN TWO HUNDRED AND FIFTEEN SPECIFICATIONS FOR CONCRETE ROADS

**215 SPECIFICATIONS FOR CONCRETE ROADS AND PAVEMENTS.**

110 or 51% specified that joints extend through entire depth of pavement.
45 or 21% specified that the joints be vertical to the surface.
22 or 10% specified that the edges of the concrete be rounded at the joints.
6 or 3% specified that the concrete be tamped at the joints.
3 or 1½% specified that the concrete be trowelled at the joints.
3 or 1½% specified that the joints be placed on a diagonal 60 degrees, 70 degrees, and 75 degree.

This table demonstrates that the details of joint construction are not sufficiently covered in most specifications as more than half of the 215 omitted most of the essentials. The joint is the weakest point in the concrete pavement, therefore it is obvious that it should be given special consideration.

In the first place it is essential that the joint be placed in a true vertical plane to the surface of the pavement. If set on an incline expansion of the concrete it will cause one slab to slide up this inclined plane and be a serious detriment.

(Slide 43-911. Showing heaved joint.)

Although under ordinary conditions this raised slab would resume its normal position often times other causes prevent a perfect resettlement which results in a serious defect in the road.

The joint must also make a complete separation or line of cleavage between the adjoining slabs and care must be taken to see that the filler extends through the entire thickness and width of the road.

It is essential that the concrete have its maximum density and greatest strength adjacent to the joint and that the surface be level, in order to minimize the amount of wear at the joints and to afford a true even riding surface free from dips or rises. The former is obtained by spading and tamping the concrete against the filler and by taking precaution that the excess mortar, which is carried ahead of the template, is not used to fill around the joint. The surface can be made true by the judicious use of the template.

If steel protection plates are used these must be set accurately and an improved surface can be obtained by using a steel float immediately adjacent to the joint. In the case of the unprotected joint best results are obtained by allowing the filler to protrude one-fourth inch to one-half inch above the surface of the road.

(Slide 43-986. Filler protruding.)

The joint is then floated with a divided or split float which gives an even surface each side of the joint.

(Slide 43-1606. Split float in use.)

Care must be observed to keep this float level so that the surface will not be inclined at the joint. The edges of the concrete slab should now be rounded or bevelled with a side walk groover or the edge of a steel float. The radius of the rounded edge should not be greater than one-fourth inch. The protruding filler is then ironed down, preferably with a hot iron, into the depression so formed and we have a joint which not only does not present a sharp corner for traffic to wear down, but which has the rounded or bevelled corner protected with a cover of bitumen. All such joints are occasionally inspected and renewed when necessary with a covering of hot bitumen and stone grit or sand. They should last indefinitely without showing any appreciable wear at a very slight cost for maintenance.

(Slide 43-399. Road with joints.)

There has been noted recently a marked tendency towards increasing the interval between transverse joints with perhaps the ultimate idea of doing away with joints except at noon and at the end of the day's work. The solving of the joint problem in this manner is practical if the taxpayers and users of the concrete highway prefer to pay for the maintenance of the cracks, which are not objectionable except insofar as they effect the appearance of the road. In the Middle West and other communities where the concrete road has been built most extensively this plan might be feasible, but the practicability of its adoption is seriously questioned where the efficiency and advantages of the concrete highway have not been thoroughly demonstrated. The public is inclined to look upon every crack as a source of failure in the concrete road and greatly to its detriment so that in certain sections of the country if the concrete highway is to flourish we must do all in our power to prevent the formation of unsightly cracks. This has been done to a great extent by the increased adoption of reinforcement to assist in withstanding the tensile stresses, both external and internal, to which the concrete road is subjected.

(Slide 43-1686. Showing reinforcement—Easton-Allentown.)

Although the matter of reinforcement is not directly included in this talk it is in a measure so closely allied with the subject of joints that I feel a few words regarding reinforcing are not out of place. It has been demonstrated that reinforcement in a concrete pavement, consisting of expanded metal or wire mesh, will, to a great extent, eliminate cracking, and furthermore that it will prevent any cracks that may form from opening up. These two facts have done much toward increasing the adoption of reinforcement and it is obvious that the expenditure for this purpose is justifiable in the results obtained. In addition any attempt to increase the intervals between joints should be accompanied by the use of reinforcement in the road.

A talk of this kind would be incomplete without showing a few views of finished pavements and giving you an idea of the complete satisfaction experienced all over the country with concrete pavements; I am showing you a finished road at Elkhart, Indiana.

(Slide 43-1690. Finished highway, Elkhart, Lincoln Highway.)

(Slide 43-1743. Finished highway, Hunt County, Texas.)

The first time in years that this overseer has been able to haul a six bale load of cotton to market with less than four mules and he has used eight mules on a five bale load.

(Slide 43-978. Finished pavement, Bay Shore, Long Island.)

A connecting link through the centre of the town to a long stretch of concrete highway.

* * *

## The Regulation of Different Classes of Traffic on Public Highways

LITTLE attention to highway improvement was given in New York State until the year 1898. Considerable work had been done in our sister State of Massachusetts, and to her we looked for our first lessons in highway work, at the same time utilizing the experience of the countries of Europe.

Up to the time of the advent of the bicycle our roads were exclusively used by horse-drawn vehicles. While it is true that work on the roads was performed by the owners abutting thereon, it was necessarily poor in quality and periodic in quantity with the result that the roads were passable for a short time in summer for wagons and for an equally short time in winter for sleighs.

It is undoubtedly true that the first impulse towards better highways came from the bicyclists. When bicycling was at its height the automobile came into practical use and the cause of highway improvement received a boost that has carried it to this day. Starting in 1898 with an appropriation of $113,872, the amounts steadily increased until in 1914, $12,078,667 were spent for highway construction, making a total of $83,389,627 expended in seventeen years. $10,000,000 was appropriated for 1915.

Starting with a few cars in 1898 and those light pleasure vehicles, the use of motor cars increased by leaps and bounds until in 1915 there were registered in New York State 208,000 pleasure cars and 23,585 commercial cars.

During this time, while the mechanical engineer was improving the gasoline engine, enabling it to pull greater and greater weight, the civil engineer was hard put to it to build and maintain a road surface that would support the enormous increase in weight and speed that the automobile brought upon it. Recourse was had to the bituminous macadam, then to concrete, brick, stone blocks, etc., in the effort to discover a pavement that would withstand the traffic and at the same time be reasonable in cost.

No universal panacea was discovered, but it was found that each pavement had its little niche which it filled well, so that today New York State is using practically every known pavement of value. Even the hitherto much despised water-bound macadam, which most people had come to consider obsolete, has received a new lease of life and New York State is building many miles of it where conditions warrant its use, and it is behaving satisfactorily.

By careful study of all the features entering into the design of a highway we are enabled to make a proper adaption of pavement therefor, but one of the things we must contend with is the mobility of the motor car. For example, we may decide that a water-bound macadam is proper for a certain locality because horse-drawn traffic predominates and the motor traffic consists of lightweight pleasure cars. Suddenly a progressive business man in a nearby town starts to deliver his goods by heavy motor trucks or else inaugurates a motor-bus line, or possibly does both. Occurences like these are very common and to be a successful highway official requires power of divination in addition to education and experience. Unfortunately there is no correspondence course on this subject and the profession of soothsaying has fallen into disrepute. Thus it is that in spite of all our forethought, unforseen conditions or changes will almost invalidate the work of the highway engineer. We have provided permanent types of pavement such as brick, stone block, etc., and placed them on foundations of concrete for use on heavily traveled highways; we use bituminous bound surface for roads supporting a medium weight traffic consisting mainly of fast moving pleasure cars; and we use water-bound macadam for roads supporting a mixed traffic of horse-drawn and motor-drawn vehicles, treating the top with bituminous material or other binder as required. With all our care, however, we will have roads designated to support light traffic forced to bear heavy and fast-moving traffic. Other expedients are necessary, therefore, and one of the most important is "Regulation of Traffic."

The scope of this regulation should be of such extent as to include all classes of vehicles that are detrimental to the road. This would include regulation of horse-drawn as well as motor-drawn traffic. The most destructive action on our highways is that caused by motor trucks and yet the motor truck is here to stay. But its action is so destructive that its continued use will mean the ruination of our pavements faster than we can maintain them.

The advantages of the motor truck over those drawn by horses are so patent as regards size and speed of load that any effort to restrain their use would arouse instant and clamorous disapproval. All that can be done in the way of regulation is to limit the weight borne by each inch in width of tire and not allow the use of any lugs or cleats which might tear up the road surface. In addition to this it is also necessary to limit the speed at which a given load might be carried.

The limiting of load borne by horse-drawn vehicles is important because of the tendency to use narrow tires. Speed, of course, is not a factor with this type, but carrying heavy loads on narrow tires is a factor tending materially to destroy our pavements.

In pursuance of section 24 of the Highway Law, for the protection of improved State and county highways, the following rules and regulations were adopted:

Section 1. No traction engine, road engine, hauling engine, trailer, steam roller, automobile truck, motor, or other power vehicle, shall be operated upon or over State or county highways of this State, the face of the wheels, of which are fitted with flanges, ribs, clamps, cleats, lugs, or spikes. This regulation applies to all rings or flanges upon guiding or steering wheels on any such vehicle. In case of traction engines, road engines, or hauling engines, which are equipped or provided with flanges, ribs, clamps, cleats, rings, or lugs, such vehicles shall be permitted to pass over such highways provided that cleats are fastened upon all the wheels of such vehicles, not less than two and one-half inches wide and not more than one and one-half inches high, and so placed that not less than two cleats of each wheel shall touch the ground at all times, and the weight shall be the same on all parts of said cleats.

The foregoing regulations relating to flanges, ribs, clamps, cleats, rings, or lugs, shall not apply to traction engines used solely for agricultural purposes, but the following requirements shall apply to such traction engines:

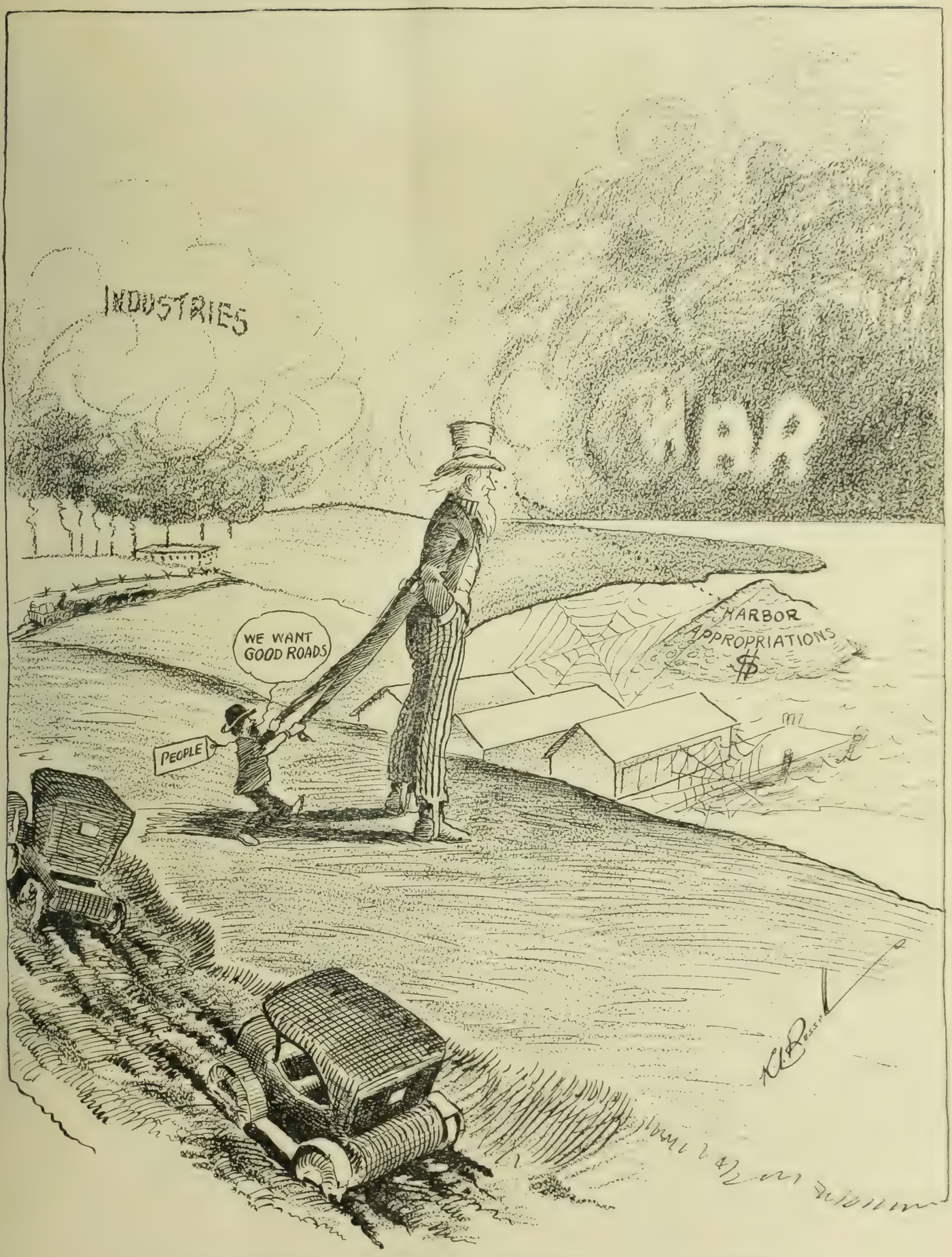
The guide band on the front wheels shall not be less than two inches in width, but no flanges, ribs, clamps, cleats, rings, or lugs shall be required upon the front wheels. The full set of cleats upon the front wheels of the original design as furnished with the engines must be used, and no rivet heads or bolt heads shall project, and the use of such traction engines for agricultural purposes shall not permit the use for hauling purposes, excepting the hauling of threshing and other agricultural equipment necessary for thrashing and agricultural purposes.

This provision shall in no case relieve the owner of any traction engine from liability for damage to roads from defective wheels.

The use also of ice picks or mud lugs shall be strictly prohibited on State and county highways.

(*Continued in July Issue*)

Lecture delivered by Edwin Duffey, Commissioner of Highways of the State of New York, Albany, N. Y., in the Graduate Course in Highway Engineering at Columbia University on February 2, 1916, in the Assembly Hall of the Automobile Club of America, New York City.




BAD ROADS COSTLY HARBORS NO SHIPS

## Public Service Corporations Support Preparedness Program

### Lieutenant-Colonel W. V. Judson Gives First Lecture

Actuated by a patriotic motive, the Chicago Elevated Railway system through its president, Britten I. Budd, and the Peoples Gas Light & Coke Company, Chicago, through its vice-president, E. J. E. Ward, have just subscribed for 25 memberships each on the Chicago Joint Committee on Military Engineering. These memberships will be given to employees of these concerns. Contributions from other corporations are looked for in the near future.

The Joint Committee was founded less than six weeks ago by members of the various technical organizations in Chicago, including the local branches of the four national engineering societies.

The Joint Committee has outlined a program consisting of a series of lectures by representatives of the Corps of Engineers of the United State army. Engineer officers of the National Guard will conduct inspection trips bringing out the military phases of road building, bridge construction, and sanitary engineering in military camps. Other phases of military engineering will be added to the program later.

The first open meeting of the Joint Committee was held Saturday, April 15, in the rooms of the Western Society of Engineers where announcements were made concerning the work. From twenty-five founders the membership has jumped to over 200 and new applications are coming in daily.

The first lecture was given Thursday, April 20, by Lieutenant-Colonel W. V. Judson, Corps of Engineers, United States Army, Chicago, at the Hamilton Club, Chicago. Colonel Judson has been in the Corps of Engineers since 1888, when he graduated at West Point. He has served in a number of capacities with the Engineer troops; as Chief Engineer in Porto Rico, and of the Department of the East at Governors Island; on the Panama Canal construction work; as Recorder of the Permanent Board of Engineers on Fortifications; as Instructor in Military Engineering at the United States Engineer School; as Military Attache with the Russian army during the Russo-Japanese war; as Constructing Engineer of seacoast batteries in various part of the country. He is now Chief Engineer of the Central Department. Colonel Judson has also done some notable work in civil practice.

Further particulars regarding the work of the Joint Committee may be had by addressing the Secretary, Robert F. Hall, 111 West Washington Street, Chicago.

* * *

## Annual Convention of the American Association of Engineers

The first annual convention of the American Association of Engineers was held on May 9 and 10 at the society rooms of the Western Society of Engineers, Chicago, Ill. The convention was a decided departure from the usual engineering society convention in that it was limited to a review of the work that had been accomplished during the first year of the existence of the association, and to discussions of ways and means for promoting its objects and for increasing the membership and power of the association. No technical papers of any kind, contrary to usual practice, were presented or discussed during the convention.

The constitution of the association was so amended as to provide for a student membership, which is to be offered to engineering students of accredited schools in all parts of the country. The dues for this new class of membership will be three dollars per annum, one dolllar of which will be for the publication of the association and the remaining two dollars for the promotion of student membership work.

National preparedness was taken up and discussed at considerable length. Resolutions were adopted to call upon the Government of the United States for blank forms for the registration of the qualifications of engineers in order that the latter may be advised by the Government as to where and in what capacity he can best serve his country in time of war. This action is aimed to prevent the engineer from joining the regular army or the militia as a private when he can enlist in such a manner that he will be of greater service elsewhere and in some other capacity. These resolutions also call upon the Government to arrange to co-operate with the various engineering associations and societies which are willing to take the matter up. At present, these bodies must take the initiative and bear all expenses that are connected with their patriotic work without support of any kind from the Federal Government.

The need for accurate military maps of the United States was also very clearly brought out at the banquet held on the evening of May 9. Up until the present time, Congress has refused to appropriate sufficient money for the making of these maps.

The American Association of Engineers now has over seven hundred members, approximately four hundred of whom reside in and in the immediate vicinity of Chicago. The balance are located in various parts of the United States, Canada, England, the Philippines, and India. During the year of the existence of the association, the amount of office space has been increased three times. Its work in exchanging information between engineers who are out of work, and the filling of vacant positions in the engineering field is well known, and the results that have been accomplished have been more than satisfactory. Since September 15, the association has offered more than 350 positions to its members and to other engineers. Estimating the customary fee that is generally charged by engineering employment agencies, the association has saved approximately $12,000 to the engineering profession. It has also severely criticized the dishonest practices of several employment agencies.

The publication of the association, the *Monad,* devoted to the social and economic welfare of the engineer, has attracted considerable attention.

The new headquarters of the association are now located at 601-604, 29 South LaSalle Street, Chicago, where engineers in all professions will be made welcome. The new officers elected to serve during the coming year are as follows:

President, Garrison Babcock; Vice President, T. B. Lambert; Secretary, Arthur Kneisel; Treasurer, O. F. Gayton; Directors, A. H. Krom and W. J. Mauer.

* * *

A solicitor for road machinery or road materials who goes about knocking everybody else who is engaged in the same line, is only making it harder for himself and everybody else to sell a similar machine or material, and the individual who makes a habit of reporting to his employer that some friend of the employer did not say or do the right thing at the right time is simply building a fire under himself, for in time the employer will find out from his friends who have been criticized by the employee that the employee was depending wholly upon some friend of the employer to land the job and that the employee was wholly inefficient.

* * *

It is not for us to undertake to say just what type should be used on the thousands of roads and streets which are being constructed every year, but engineers and officials should determine as nearly as possible just what traffic will go over the particular road or street which is contemplated to be constructed, and then stand up like men and say so, and not "pussy-foot" around about the job and undertake to make every manufacturer believe that he has a chance for the job and then knock every one of them in the head and suddenly fix a "type for the place" which was never heard of before.

* * *

Heretofore the practice of this publication has been to make its front covers from photographs showing finished roads and finished streets. Hereafter our practice will be, in most cases, to have our front covers made from photographs showing appliances and machinery engaged in actual construction.

The front cover of this issue is made from a photograph showing a motor truck delivering and dumping crushed stone for the lower course of a road, and we are informed by the contractor in charge of the work that the truck shown on the front cover is daily delivering as much stone on the job as could be delivered by twelve teams of horses, which would cost the contractors $4.50 each per team per day, or a total of $54. The truck is dependable while you cannot depend upon twelve drivers and twenty-four horses being on the job every day—a man sick, a horse sick, or something else always happens.

# Review of New York State Work for 1915

By H. Eltinge Breed, First Deputy, New York Commission of Highways

EDITORIAL NOTE—The subject matter contained in this article is taken from an address made by Mr. Breed at the recent Good Roads Week at Cornell University, Ithaca, N. Y.

YOUR programme has been a comprehensive one. It has been very pleasing to note that the practical aspect of road building has been emphasized here in the selection of topics and discussions, and it is my personal opinion that the men from the outside who have attended the Conference at this University will derive more benefit from the papers that have been read, as well as from the resulting discussions, than was anticipated when Good Roads Week was inaugurated. I am also of the opinion that many benefits will be derived from these meetings by the men of the University who have been in attendance, and that the week's work will be of much value to those who intend to follow highway engineering as a profession.

A few years ago, a highway engineer to a large majority of the taxpayers was a joke; good enough, perhaps, to add the frills for such communities as had money to waste, but really quite unessential. The statement was common that any one could build a road, and the roads were a sorry witness that any one at least might try. However, good pioneer work was soon done by the bicycle clubs in furthering the cause of good roads. Afterwards, the automobile associations took it up, with a keener realization that if road building were to advance it must, like all other large undertakings, be treated from a scientific standpoint in such a manner as to secure the best results. So different organizations were formed and different highway departments were organized to carry on this work. The results speak for themselves. Today the profession of highway engineer is one of much relative worth and carries with it as much standing as any other branch of the profession. This result is largely due, not only to the work that has been done in the field, but also to the co-operative interest and work of universities like this one in educating engineers along the lines of highway work.

During the past year our department has had many inquiries from road commissioners and town, village, and city officials, asking for recommendations as to the best types of pavement to use, sometimes giving a general description of the conditions which they were to meet. In all of the replies to these requests, it has been our policy to recommend that they obtain the services of some highway or paving engineer of recognized standing who could personally get in touch with the local conditions and advise them, not only of the best practice today, but of the best practice to suit their immediate needs.

We have adopted this policy because so many considerations enter into the selection of the type of pavement to be used that if all the factors involved are not duly weighed, there will be a large waste of public money. Before continuing, I should like to emphasize the fact that to design a highway properly, accurate knowledge of the chemical and physical properties of the materials used, together with information and data in regard to experimental and practical usage is essential. Many failures and a large waste of public money may be charged to the score of experimental chance and lack of adequate knowledge.

In order to be prepared to design a highway properly, it is not necessary to make an experiment of every piece of work, but simply to make observations, for in every State of the Union and in every country of the world, experiments are being carried on in pavement work, with many needless, wasteful duplications. With a clear insight into the materials used and the methods employed, one may gain enough knowledge through observation to devise with good judgment, better types than could otherwise be obtained, and may thereby win the satisfaction of not having wasted public money in needless experimentation. One cannot too forcibly emphasize the fact that when experts differ widely, the truth of the proposition is only discernible after true and exact consideration has been given to every detail, chemical, physical, practical, constructive, and otherwise.

The remainder of this talk will cover the work done by the New York State Commission of Highways in 1915.

Something of the magnitude of the work that is being done in New York State is shown by the following facts.

During the year, 259 contracts, covering 1,102 miles of road were prepared and awarded for construction work (new work). For construction and repair, 184 contracts covering 1,714 miles of road were prepared and awarded, as well as thirty-four broken stone contracts; 19,000 proposals for construction contracts and 12,000 proposals for maintenance contracts were printed and furnished to contractors. Detailed examination has been made of the final estimates for 179 contracts. In the blueprint room, 127,000 blue and white prints were made, using 636,000 square feet of material. In addition to this, in the head office, plans were examined and approved for approximately 1,350 miles of construction work. Part of this was placed under contract during 1915, and included 387 miles of plain water-bound macadam; 163 miles of water-bound macadam with bituminous surface treatment; 352 miles of bituminous macadam, penetration method; 2.2 miles of bituminous macadam, mixed method; 119 miles of Portland cement concrete pavement; thirty-one miles of brick pavement, and twenty-nine miles of all other types, making a total of 1,073 miles.

During the year 1915, there were completed and officially accepted, 759 miles, and there were completed, but not in time for official acceptance, 324 miles, making a total of 1,083 miles of road completed during the season.

This mileage would reach through Syracuse, Watertown, and Malone, New York, to Montreal, thence to Plattsburg and Albany to New York City, and thence through Middletown and Binghamton to Ithaca. After one had made this circuit, there would still be enough miles of improved road left over to carry one to Rochester.

There are under contract at the present time 739 miles of highway. The large mileage of unfinished work has been due to three general reasons, the first of which is that in the main the season was a bad one, due to long and protracted periods of wet weather; the second, that owing to large demands upon aliens by the countries at war and also to the large demand upon labor by the increased manufacture of war munitions, there was great scarcity of labor throughout the country; and third, that a percentage of our work being let during the summer season, together with the fact that many counties were slow in procuring rights of way, did not make it possible for the contractors to proceed with their contracts in time to complete them during the year.

Up to the present time the maps in use have been inadequate, so with the idea of giving the public better information, we have prepared two maps to be included in our annual report. The first one will include our system as built, with work under construction on State and county roads. It also will include future State systems as laid out, but will not include the the future county system, or "red line" as it is commonly known, which is subject to such frequent changes. The second map is to be the same as the first, except that plus everything in the first map it will show any local connecting roads which would connect up with our system, together with roads that have been improved by towns and counties through which they pass and are what one might call improved stone roads. This map will have enough places indicated on it so that one can readily orient one's self in a given location, and some of the places of general scenic and historic interest will be indicated by a suitable legend near the title. It is our further intention, just as soon as these two maps are finished, to produce a map on a larger scale that will have practically all of the advantages of the United States Geological sheets and cover all the features enumerated for the two maps above mentioned, in much greater detail, and which will indicate most of the places of scenic and historic interest throughout the State. This map will be prepared in such a manner that additions may be made, and it is the idea of the department, I think, to provide for its sale, as it will be rather more than an ordinary proposition in the matter of expense.

*(Continued in July issue)*

# Better Roads and Streets

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Subscription Agents Wanted Everywhere. Good Commissions


You can judge a man by his attitude toward roads.

* * *

Good roads and good streets mean good business.

* * *

The greatest foe to good roads is water. The past winter and spring have demonstrated that.

* * *

There are willing workers, and there are loafers who are always willing to enjoy what somebody else provides.

* * *

Those that have the will, the spirit, the good roads religion, must lead the way out of muddom and hubdom.

* * *

If we continue to talk without action, good roads in our community will be as indefinite and distant as the milky way.

* * *

The evolution of highways parallels the evolution of the whole scheme of transportaiton.



The New Way

* * *

A road is a tie that binds and the longer the road the more far-reaching is its binding and brother-making power.

* * *

Making bad roads into better roads is certainly a splendid example of "thrift."

* * *

Have you ever noticed that in towns immediately after a street has been paved or resurfaced, pedestrians and vehicles begin to multiply on those streets?

Bad roads represent waste of time and energy; better roads represent economy.

* * *

Savages do not make roads; their paths follow the lines of least resistance and go around obstructions. Civilized man is a road maker, and the progressiveness of a community may be gauged by its roads. The higher the state of civilization the better the roads.



The Old Way

* * *

Those of you who are yet living along bad roads are bound hand and foot while the elements play about you. When the rains come you are stuck in the mud, blocked from the markets and from the profits which would be yours but for your own stupidity.

* * *

Senator Harding, of Ohio, certainly hit the nail on the head when, speaking before the United States Senate, he said: "The biggest question of the whole road problem is that of maintenance, and the biggest crime in public affairs to-day is the wanton waste resulting from lack of proper maintenance of roads which cost millions to build."

* * *

The Good Roads Machinery Company, well-known dealers in all kinds of road and street machinery, have just issued a new booklet devoted exclusively to concrete mixers, which they are putting out under the name of "Good Roads." The booklet can be had on application to the Good Roads Machinery Company, Kennett Square, Pennsylvania.

* * *

The Standard Brick Company, of Crawfordsville, Indiana, has taken out a license from the Dunn Wire-Cut Lug Brick Company for the manufacture of wire-cut lug paving brick. This makes thirty companies operating forty-eight plants now engaged in the manufacture of wire-cut lug brick. The Standard Brick Company is an established concern with a daily capacity of 25,000 brick, but it is enlarging its plant to a capacity of 35,000 brick daily with the necessary additional kilns to handle the output. The plant now has seven kilns of 70,000 capacity each.

* * *

At the annual meeting of the Cement Products Exhibition Company, held May 23, the following officers were elected: B. F. Affleck, president; A. Y. Gowen, vice president; Blaine S. Smith, secretary, J. U. C. McDaniel, treasurer.

* * *

A publication has just been issued by the Bureau of Standards, Department of Commerce, on the "Compressive Strength of Portland Cement Mortars and Concretes," which will be of interest to contractors and engineers and, in fact, to all users of cement. Copies of the publication, "Technologic Paper No. 58," may be obtained free upon request to the Buread of Standards, Washington, D. C.

* * *

The accompanying photograph shows the ingenuity of one contractor in overcoming a rolling problem on a job of concrete paving in Glenwood, Iowa. The cut shows a Chain Belt Paver No. 15, manufactured by the Chain Belt Company, Milwaukee, Wisconsin, equipped with extra steel tires slipped over




*Columbia Avenue, Vandergrift, Penna.*
*Tarvia Mixed-Macadam over worn brick pavement*

# *Tarvia over Brick—*

WHAT to do with a worn-out brick pavement has long been a problem to municipal engineers. Rough, noisy and dirty, such old pavements are a nuisance.

In the instance pictured above (and in many other recent cases), the problem has been solved by applying a wearing surface of crushed stone and Tarvia over the old brick pavement.

Tarvia alone among the bitumens used for paving and road making possesses the capacity of adhering to cold surfaces. Accordingly it bonds readily to an old and rough brick pavement which really makes an ideal foundation.

In the above instance "Tarvia-X" was mixed with a suitable grade of crushed stone in an approved power mixer and spread over the brick to a depth of three inches. It was then compacted by rolling to a finished depth of two and one-half inches. This has proved to be an ample thickness.

23,000 square yards of brick pavements were covered in this manner at Vandergrift, Penna., and there has been no scaling off or rolling up of the surfacing material. The above photograph was taken after the street had been subjected to a year of lively traffic.

This method of resurfacing old, worn-out brick pavements has been used for several years with great success. The same general method is used over other types of block pavements.

We shall be glad to give the technical details to any engineer or property owner who is interested.

*Booklets on request. Address our nearest office.*

***Special Service Department***

This Company has a corps of trained engineers and chemists who have given years of study to modern road problems.
The advice of these men may be had for the asking by any one interested.
If you will write to the nearest office regarding road problems and conditions in your vicinity the matter will have prompt attention.

The *Barrett* Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh
Detroit Birmingham Kansas City Minneapolis Salt Lake City Nashville Seattle Peoria
THE PATERSON MANUFACTURING CO., Limited: Montreal Toronto Winnipeg
Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

TRADE B MARK

the regular tires. The outer half of each tire was then filled with cement and sand mixed one and two respectively.

Mr. Samuel Friedman, of Omaha, Nebraska, the contractor who owns the above mixer and equipped it as described, writes



**Chain Belt Paver No. 15, owned by Samuel Friedman, Omaha, Neb., being used as road roller**

that owing to a delay in the shipments of coarse aggregates on this job he was enabled to roll the entire sub-grade with this improvised roller. Mr. Friedman further states that the entire expense was approximately $75 or about what shipping a roller for the work would have cost him.

* * *

## A New Maintenance and Construction Truck

Almost simultaneous with the announcement of the White Company, Cleveland, of the completion of its new road maintenance and construction truck, engineers from various parts of the country visited the White factory to inspect the new efficient and economical good roads machine, and these visits were followed by receiving orders for this type of truck from St. Louis, San Francisco, Indianapolis, Lexington, Ky., Fond du Lac, Wis., the county of Onandago, N. Y., Roads Preserving Co., of Cincinnati, Ohio, and the Gas Light Company of Atlanta, Ga. The St. Louis truck, a five-ton model, has been delivered.

The combination truck embodies in one complete unit of equipment facilities for sprinkling and flushing streets, oiling roads or spreading hot asphaltic oils, and with the iron tank removed the truck may be used with an ordinary body for general haulage purposes. It eliminates the need for individual pieces of road machinery which can be used only during certain seasons and for specific work. It performs the same duties more efficiently and at a great saving of time and labor expense.

This truck is available in two sizes, a three-ton chassis with an 800-gallon tank, or a five-ton chassis with a 1,000-gallon tank. Both have forty-five horsepower motors. The tanks are made of heavy steel, hot riveted and calked inside and out. The 1,000-gallon size is forty-eight inches in diameter and ten feet six inches in length.

The truck has many distinct advantages, two of the chief features being the rotary displacement pump and the new improved heating system. The pump is driven by a lay shaft from the rear of the truck transmission case and may be used to fill the tank with oil or water through an intake pipe in the front. It saves time also in loading the tank directly from freight cars, because the dump has a lift of thirteen feet and consequently the tank need not be on a lower level than the cars. The high temperature possible by the new heating system eliminates the need for separate heating plants, erected alongside the freight cars or by the road.



The heater located in a separate section in the rear of the tank can raise the temperature of a tank full of material at the rate of one degree a minute and maintain 350 degrees steadily. While the material is being heated, the pump keeps the oil in constant circulation carrying it out the top down a pipe at the side and back into the bottom of the tank. This agitation overcomes the tendency of the heavier oils to settle on the bottom of the tank and become thick or gummy. Heat is delivered uniformly to every one of the regular boiler flues in the one-third lower section of the tank, and there is no danger of fire or overflow. Other types that heat with flash burners in a false section of the tank frequently overheat the flues nearest the burners, setting fire to the liquid.

The pump delivers oil to a set of sixteen nozzles in the rear of the truck and spreads it uniformly over a strip of road eight feet six inches in width. If desired, these nozzles can be moved to the right or left of the center of the road a distance of two feet. The eighty pounds pressure from the pump drives the oil down into the crevices of the road surface, binding it firmly. The nozzles and pump pressure are regulated by a man from a small seat on the right side and the rear of the truck.



After the truck has been used for oiling or spreading asphalt, the tank can be quickly cleaned by circulating kerosene through it. The kerosene is stored in a small tank on the left side of the truck. The truck is then ready for sprinkling. In flushing, the pump delivers 300 gallons of water per minute covering a strip of pavement from eight to twelve feet, while the sprinkling nozzles cover from twenty to forty feet.



# New White Combination Truck
## *for*
# Road Maintenance and Construction

IT combines in one compact unit of equipment facilities for sprinkling and flushing streets, oiling roads or spreading hot asphaltic oils. The iron tank that holds these liquids may be easily detached and the truck used with an ordinary body for general haulage purposes. This truck eliminates the need for individual pieces of road machinery which can be used only during certain seasons of the year and for special work. It performs the same duties three times as fast, twice as efficient and at one half the cost of operation.

Oil or water may be taken into the tank at the top or through an intake pipe at the front by means of a rotary displacement pump. In loading the tank directly from freight cars the truck may be on a higher level than the cars, because the pump has a lift of thirteen feet. The high temperature possible by the special heating system eliminates the need for separate heating plants. The pump delivers oil to a set of sixteen nozzles in the rear of the truck and spreads it uniformly over a strip of road 8 feet 6 inches wide. The 80 pounds pressure drives the oil down into the crevices of the road surface, binding it firmly. The nozzles and pump pressure are regulated by a man from a small seat on the right side and the rear of the tank. The pump may be used also to agitate the liquid preventing the heavier oils from settling to the bottom of the tank.

The heater located in a separate section on the rear of the tank raises the temperature of a tank full of material one degree a minute and can maintain 350 degrees steadily. It also insures uniform heat to every one of the regular boiler flues, thus overcoming the possibility of the flues nearest the burners becoming overheated and setting fire to the liquid.

This type of truck is available in two sizes—3-ton chassis, 45 H. P. with 800 gallon tank and 5-ton chassis, 45 H. P. with 1,000 gallon tank.

Write for special circular giving detailed information.

## THE WHITE COMPANY
CLEVELAND

*Largest Manufacturers of Commercial Motor Vehicles in America*

The great number of requests coming from contractors, engineers, and road and street officials for copies of BETTER ROADS AND STREETS, and the particular mention of articles which appear in it, is the best evidence that it is considered a valuable publication.

* * *

The Chambers Concrete Mold Company, Grand Rapids, Michigan, are placing on the market an adjustable concrete mold for use in constructing concrete culverts, sewers, drains, etc., that has a great many excellent features. This mold is fully described in their new illustrated folder, copy of which may be had on request to the above company.

* * *

Every publication is anxious to increase its subscription list as rapidly as possible, and nothing can be of greater help in doing this than for satisfied subscribers and readers to recommend the publication to their neighbors and friends. Better yet, as soon as you finish reading your issue, hand it to some friend and ask him to read it and subscribe for it.

* * *

We urge upon our subscribers to give early attention to their remittance for renewal subscriptions just as soon as renewal notice is received. Don't lay it down, or stick it up in a pigeonhole, but give it your attention at once, for they will not receive the next issue unless remittance for renewal is received at this office.

* * *

Individuals and firms pay for advertisements in any publication expecting to procure business in return. We are not knocking any individual or firm who does not advertise in BETTER ROADS AND STREETS; but our advertising columns show for themselves, and we recommend every one of them to everybody who reads and has power to purchase.

* * *

We ask our readers to compare the large amount of live matter which appears in this publication with that which appears in other publications, and assure them that we will continue to make BETTER ROADS AND STREETS better in the future than it ever has been in the past.

* * *

## Cost of Street Paving in Amsterdam

[Consul Frank W. Mahin, Amsterdam, Netherlands, Jan 17.]

The total cost of the street paving in Amsterdam (or the cost of relaying the present paving) was about 12,250,000 florins (nearly $5,000,000). The cobblestone paving covers 1,100,000 square meters (1 square meter=1.196 square yards), costing five florins ($2.01) per square meter; brick paving, 2,750,000 square meters, costing two florins ($0.80) per square meter; asphalt, 111,000 square meters, costing 6.20 florins ($2.49) per square meter; and wooden blocks, 38,000 square meters, costing twelve florins ($4.82) per square meter. Besides, there are 26,000 square meters of asphalt footways, costing three florins ($1.21) per square meter.—(*U. S. Commerce Report.*)

* * *

## Notice to Contractors

Bids will be received until 12:00 noon, Thursday, June 29, 1916, by the County Court of Wetzel County, West Virginia, for the construction of approximately fifteen (15) miles of improved roads in Church District of said Wetzel County.

A certified check for three (3) per cent, of the amount of the bid must accompany each bid. Successful bidders will be required to furnish a bond substantially in wording and figures of the form attached to specification and contract.

Plans for this work may be seen at the office of the County Clerk, New Martinsville, West Virginia; at the First National Bank, Hundred, West Virginia; and at the office of the engineer, J. Russell Wilson, First National Bank Building, Mannington, West Virginia.

The Court reserves the right to reject any and all bids.

* * *

To carefully determine the "type for the place" will be to relieve engineers and officials of a great deal of annoyance to themselves and save large sums of money to manufacturers of both machinery and materials.

Every promoter and salesman of a machinery or material manufacturer is endeavoring to do the largest amount of business, but if engineers and officials will arrive at a conclusion in the early stages of the contemplated construction, determine the "type for the place," and make their conclusions publicly known, then promoters and salesmen can get away from that locality and spend their time and effort in some other locality where their type is the one wanted for the place, and in the end reduce selling costs and make possible a lower price for the material which is contemplated and will be used at a place.

* * *

There are thousands of miles of roads and streets which are in great need of new construction, repair, and maintenance, and in considering the new work to be done the "type for the place" with a full knowledge of future traffic conditions should have most careful thought.

* * *

The Trussed Concrete Steel Company, makers of the Kahn Mesh for re-inforcing concrete roads have just issued a new book on "Kahn Pressed Steel Construction." In this book is described an improved type of fireproof floors and the construction of partition and bearing walls. This booklet or information regarding their Kahn Mesh and all re-inforcements required in concrete roads and concrete work will be sent to any one on application to Trussed Concrete Steel Company, Youngstown, Ohio.



No. 1. Location of Road.

* * *

## A Valuable Book

In this day of advanced methods of advertising the literature produced by many manufacturers contains much valuable information pertaining to the work to which the advertised product is adopted. This is particularly true in the case of a recent book of 128 pages entitled, "Road Construction and Maintenance," published by the E. I. du Pont de Nemours Powder Company.

The book is one of the best of its kind ever published, is written in a clear, concise, and understandable way, deals with



No. 2. Blast of Hard Ground in Road Work.

the subject of road building from the time of its location and construction to the maintenance of it afterward. The methods



## Dust Is Death in Powder Form

Ever analyze a cloud of dust? On an average, you'll find it composed of something like this: pulverized stone, flaked cigar butts, decomposed insects, putrid animal matter; together with all kinds of granulated filth, tracked and blown from unhealthful sources. With every passing vehicle churning this material into clouds of germ-laden dust, there is great danger to the public health. Something must be done!

# Atlantic Asphalt Road Oil

is the logical remedy for the dust evil. It is just the right consistency to soak up every particle of dust and convert it into useful road material. It lays the dust and allays the menace to the throats and lungs of pedestrians and motorists.

Atlantic Asphalt Road Oil is specifically prepared for the purpose of converting dusty roads into clean, sanitary, inviting streets and highways. The name "Atlantic" is your assurance of quality and fitness. Write for details. No obligation.

ATLANTIC ASPHALT

**The Atlantic Refining Company**

**Philadelphia and Pittsburgh**

THE ATLANTIC REFINING COMPANY ATLANTIC

of construction, materials, and machinery are all taken up in its several chapters which are profusely illustrated with photographs showing actual scenes of construction and maintenance.

A postcard request to the E. I. du Pont de Nemours Powder Company, Wilmington, Delaware, will bring the book to any

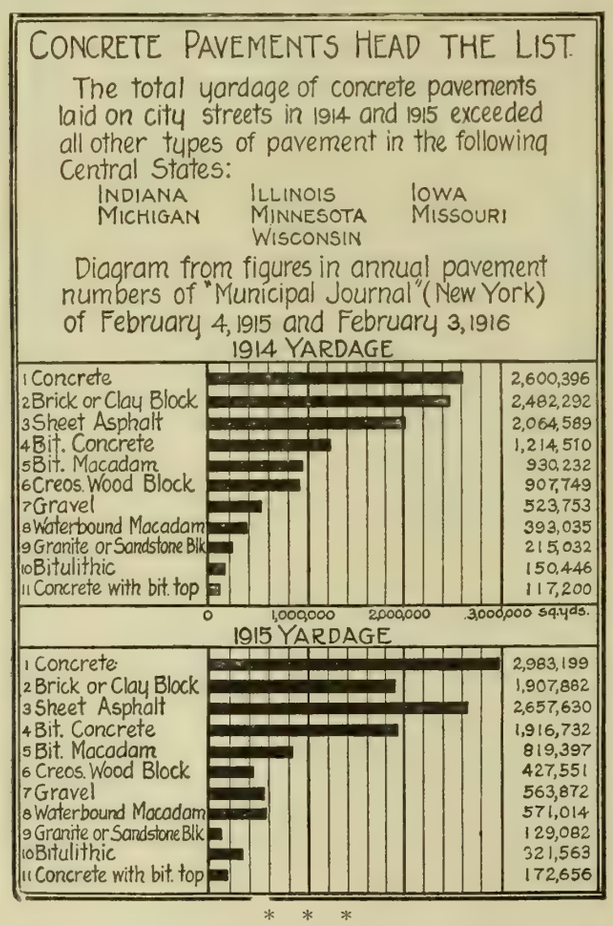


No. 3. Use of Explosives in Road Building.

person interested in road construction and maintenance who will find it of real assistance to them in their work and a valuable addition to any library.

* * *

The following diagram, prepared by the Universal Portland Cement Company, Chicago, clearly presents from the source mentioned thereon, the yardage of all commonly used types of pavements in the seven States named. Comparisons being shown between 1914 and 1915.




* * *

## Building Forty Miles of Composite Road

Contracts for a type of road certain to attract wide-spread attention have just been awarded in Monroe County, Michigan. Judging from long-time tests on the examples of the type to be found here and there—tests that cover in some cases a period of ten years—the road promises to go a long way toward the solution of the highway problem of the country so far as it relates to rural roads.

The Monroe County road, of which about forty miles will be built, consists of a five-inch concrete base with six-inch concrete curbs and a wearing surface of two-inch asphalt macadam, the specifications calling for Bermudez lake asphalt as the binder for the wearing surface. Contracts for the first eleven miles were let at a remarkably low figure—a little under $12,000 per mile.

Considering the low initial cost and the substantial character of the road, the thought at once occurs that the Michigan county may be constructing what is destined to become the American standard road. Several reasons point to this conclusion.

In the Michigan road there will be combined to the highest advantage two of the best road materials known to highway engineers. They are natural lake asphalt and Portland cement. Through this combination the quantity of each will not only be reduced at considerable saving, but with the further advantage of permitting each to perform the function to which it is best adapted. It is needless to say that the foundation of a road is an extremely important factor in seeking to obtain maximum durability, and no material answers the purpose better than concrete. It is when we seek to carry concrete up to the required grade, making a concrete road throughout, that costs begin to multiply. This is due to the fact that we must have not only a rich, dense mixture, but one placed with extreme care and further protected by expansion joints, reinforcement, and thorough curing. When concrete is used as a foundation, however, it may be of a slightly leaner mixture and is rapidly laid. The difficult and complex engineering details attending the construction of the all-concrete road are dispensed with. All this means material reduction in cost.

In the matter of a wearing surface, none is better suited to country traffic than asphalt macadam. It is not only a mudless,



Fig. 1. Condition of the Monroe County, Michigan, road in August, 1915. Construction of a new road with a concrete base and asphalt macadam wearing surface is now under way.

dustless pavement, but possesses the resiliency required for horse traffic. It is durable and can be easily repaired. Sustained by an unyielding foundation, it would reduce maintenance to the minimum.

A further important consideration in the case of the composite type of road is the fact that its general adoption would lead to the substitution of economic co-operation for the costly competition that has attended the construction of the separate types of roads popularly designated as the concrete road and the bituminous macadam road. By co-operating in the interest of the taxpayer, neither of the great industries promoting the exclusive use of its material would suffer decline in consumption of their products. On the contrary, the combined road is such an attractive proposition to the taxpayer that largely increased mileage would result.

It would be difficult to conceive of a more attractive road than the type described, and if Michigan can build them at the price given—which is $3,000 per mile cheaper than the present price given for concrete roads by the Portland Cement Association, and nearly $1,000 a mile cheaper than the figures on bituminous macadam as given by the association—every section of the country similarly situated as to materials and labor, can follow Monroe County precedent.

Further economies suggest themselves the longer the composite road is considered as a standard type. One of the re-

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# Road Building Equipment

Enables the Good Road Builder to Complete Each Job in the Least Possible Time

V-Shaped Dump Cars, Platform Cars, Gondolas, Portable Track, Switches, Frogs, Rails, Steel Ties, Spikes.

**For Sale** or **For Rent**

*Write for Sale and Rental Terms.*

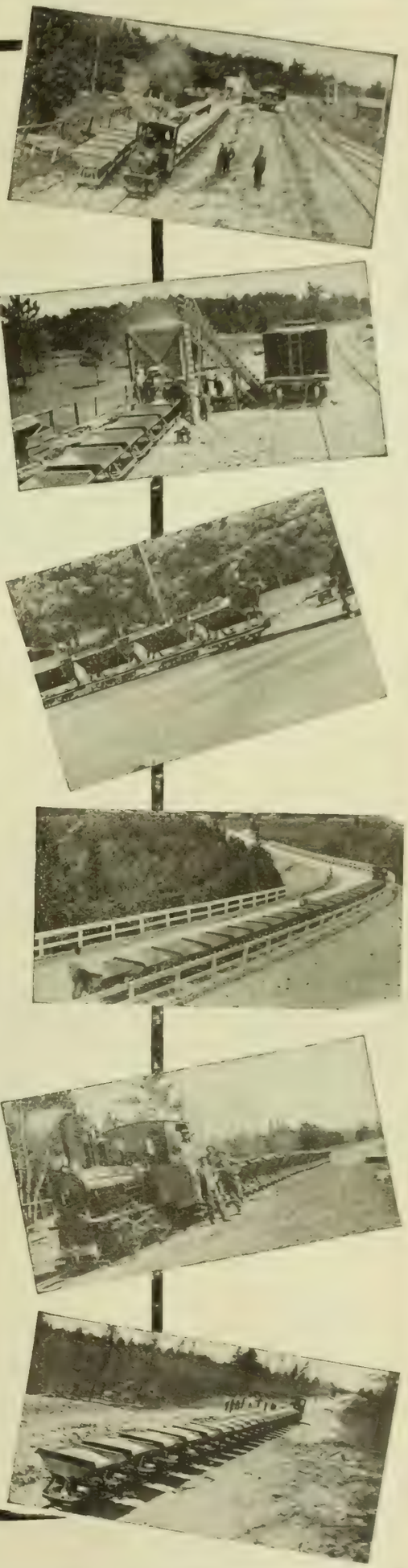
OAK

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tarding factors in highway improvement at present is our miscellaneous types of roads. Contractors are called upon to build one type of road to-day, another to-morrow. They are constantly encountering new problems which entail high bids to guard against unforseen difficulties. Engineers have the same problems in design. But with the general adoption of a



Fig. 2. Rolling the sub-base of the Monroe County, Michigan, road, which wil be a notable example of durable and economical highway construction.

single type, methods of construction would become thoroughly standardized, thus simplifying matters for the engineer and contractor. The matter of chief importance, however, is the economy of the proposition from the taxpayer's point of view.



Fig. 3. Sub-grade prepared for the concrete base and curbs. Steel side forms are shown in place.

as it will mean to him greatly reduced initial cost of roads, minimum outlay for maintenance, and increased traffic efficiency.

* * *

## Nineteenth Annual Meeting of the American Society for Testing Materials

The Nineteenth Annual Meeting of the American Society for Testing Materials will be held at Atlantic City, N. J., June 27 to 30, inclusive. It had originally been planned to continue the business sessions of the meeting to Saturday, but later this was changed so that Saturday might be a day of recreation.

As in past years, the meetings will be held at the Hotel Traymare, the largest and finest resort hotel in the world. The following special rates have been granted by the management of the hotel for the members of the American Society for Testing Materials and their guests. All rooms at the Traymore have private bath.

One person, small room, without ocean view, Amer. plan $5.00
One person, small room, with ocean view, American plan. 6.00
Two persons, large room, without ocean view, Amer. plan 10.00
Two persons, large room, with ocean view, American plan 12.00
One person, small room, without ocean view, Eur. plan.. 3.00
One person, small room, with ocean view, European plan. 4.00
Two persons, large room, without ocean view, Eur. plan..5.00
Two persons, large room, with ocean view, European plan 6.00

All of the above rates are per day, and, as the Traymore is always crowded to overflowing during this meeting, reservations should be made as far in advance as possible. The hotel management, as has been its custom for many years, furnishes the society with the meeting room, convention hall, committee and registration rooms without charge, and it is the request of the society that members and guests stop at the official headquarters.

The returns from the letter ballot on recommendations for appointments on the Nominating Committee for Officers were canvassed by a Committee of Tellers appointed by the president of the society, Mr. T. Y. Olsen and Mr. F. M. Register. From the report of this committee to the Executive Committee, it appeared that 193 legal ballots had been cast, of which 189 bore two names each, and 4 bore one name each, the total vote of 382 being distributed among 160 members. Exclusive of the votes cast for members of the Executive Committee, which the latter decided to disregard, one member had received twelve votes, two eleven votes, two nine votes, three eight votes, two seven votes, three six votes, seven four votes, and the remaining 140 members fewer than four votes each.

The Executive Committee made the following appointments on the Nominating Committee in strict conformity with the indications of the vote:

*Nominating Committee*—Members: C. D. Young, J. A. Capp, Richard L. Humphrey, John McLeod, Rudolph J. Wig, G. W. Thompson, Alternates; C. F. W. Rys, John M. Goodell, S. T. Wagner, John B. Lober, George S. Webster, G. Aertsen.

Attention is called to the fact that four of the six members of the Nominating Committee served in a like capacity last year. The Executive Committee, after taking this circumstance into consideration, felt unwilling to assume the responsibility of discriminating against these members on the score of previous service. It is intended to obtain the sense of the members present at the approaching annual meeting as to the desirability of defining the future policy with reference to successive appointments on the Nominating Committee.

Acceptances of their appointments have been received from every member and alternate of the Nominating Committee with the exception of one alternate.

The Nominating Committee was accordingly constituted of the above six members and the last three past presidents of the society. At a meeting of this committee held in New York City, which was fully attended except for the absence of Past President Robert W. Hunt and Mr. G. W. Thompson, the following nominations were unanimously agreed to:

For President, A. A. Stevenson.

For Vice President, S. S. Voorhees.

For members of the Executive Committee: W. H. Bassett, John Brunner, G. W. Thompson, and F. F. Turneaure.

Each of the above nominees has indicated in writing his acceptance of his nomination, and, as provided in the by-laws, these nominations are formally announced to the membership at large. The by-laws also provide that "further nominations, signed by at least twenty-five members, may be submitted to the secretary-treasurer in writing by May 20, and a nomination so made, if accepted by the member nominated, shall be placed on the official ballot which shall be issued to the members between May 20 and June 1."

The total membership reported at the last annual meeting—that is the total up to June 15, 1915—was 1,842. From that date until April 20, 1916, 303 applications for membership have been approved, 102 members have resigned, sixty-six members have been dropped for arrears in dues, and fourteen members have died, making the total membership on April 20, 1,963, which represents a net increase of 121 since June 15, 1915. The largest net gain in membership for the yearly periods between annual meetings is 155, which was reported last year, but during that year the net gain from the date of the annual meeting in 1914 to April 20, 1915, was only seventy-one, as compared with 121 this year.

# One Shipment of Littleford Tar Heaters

## for the City of Chicago



"There are reasons." Among them *one* stands out—the Littleford has *double the heating surface of any other make.*

They are easily **accessible;** are **large wheeled** and with **low center of gravity; large grate surface with cast bars;** protected fire box; strong steel furnace and kettle. *"A Good Thing—Improved."* *"A Heater With a Long Life."*

*Send for Complete Illustrated Catalog of Littleford's Money Savers for Contractors.*

**LITTLEFORD BROS., 400 E. Pearl Street, Cincinnati, Ohio**

*THE SOLUTION OF THE SIGN PROBLEM*

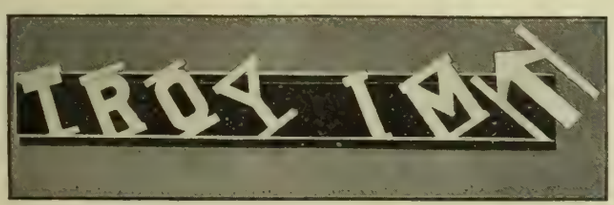
# THE INTERCHANGEABLE CROSSROADS DIRECTION SIGN

Gives any reading desired, for permanent or temporary signs: COLUMBUS 12 M., DANGER, SLOW DOWN, BRIDGE OUT, ROAD CLOSED, DETOUR—1 m. S. 1 m. W., USE THE WHOLE ROAD, Etc.
Just the thing for ROAD NAME SIGNS and BRIDGE NUMBERS.




Interchangeable Sign (Assembled)

A
Plain
Permanent
Indestructible
Weatherproof
All-Metal
Sign




Sign (Disassembled Showing Separate Letters and Back Plate)

Notice Top and Bottom Extensions Insuring Perfect Alignment and Proper Spacing Between Letters.

Order crossroads direction signs as you would anything else. Just say how many. Ten, fifty or a thousand at a day's notice. Keep a few on hand and put them up as you need them; it takes sixty seconds to permanently assemble a twelve letter sign.

THE INTERCHANGEABLE CROSSROADS DIRECTION SIGN conforms to the specifications of the State Highway Department.

**The Ohio Culvert Pipe Co.,** Tiffin, Ohio, U. S. A.

"ACME" (NESTABLE)
Corrugated Metal Culverts
(*Shipped Set-up or knocked-down as you prefer*)
Are made exclusively of heavy gauge
NO-CO-RO METAL
TRADE-MARK REG. U.S. PAT. OFF.
—ANTI-CORROSIVE
(Licensed Under Patents Granted to The International Metal Products Co.)
Guaranteed (by surety bond) to analyze 99.90% pure—i. e., not to contain more than .10% (10/100 of 1%) in the aggregate of carbon, manganese, phosphorus, sulphur and silicon and to be of uniform and homogeneous composition—an exceptional rust-resisting culvert material.
"ACMES"—the most practical corrugated culvert made—have records of actual service for eight (8) years under varied conditions without a sign of disintegration yet—practically assuring permanence.
Our big "ACME" Catalog G-2—hadn't you better have it?
THE CANTON CULVERT & SILO CO.
MANUFACTURERS
CANTON, OHIO, U.S.A.

The Sunbury Automatic Car Unloader
Highest Efficiency Lowest Operating Cost
Absolutely Automatic on Sand, Screenings, Slag, Stone, Small Coal, or Other Loose Material.
WRITE FOR CATALOGUE.
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It is confidently expected, therefore, that the total membership at the time of the approaching meeting will be substantially above the two-thousand mark, and that it will represent the largest net annual gain in the history of the society.

Business and technical meetings will be held morning, afternoon, and evening with the exception of Wednesday afternoon, which will be reserved for a recreation period, with the annual golf games, and Thursday evening, on which will be held the annual smoker at the Traymore.

The arrangement of the program differs in no important details from the usual program. Special sessions will be held for the reports of committees and the reading of papers on tests and testing, cement and concrete, aggregates, brick and road materials.

Better Roads and Streets will be represented at the meeting by the associate editor, and the usual full account of this, one of the most important technical meetings held in this country, will be presented to our readers in the succeeding issue.

* * *

## Automobile License Fight in Michigan is Settled

The Michigan State Highway Department and the road officials of every county in the State of Michigan are rejoicing over a decision handed down by the Supreme Court of Michigan the latter part of May. The law in question, known as the Newell Smith Horsepower Weight Automobile Tax Law, was passed by the last legislature, and is based upon a bill introduced by Representative Newell Smith, of Gratiot County. As originally introduced, the bill contemplated that the State highway fund would receive all the taxes collected on automobiles according to their horsepower and weight. Detroit and Kent County legislators led a fight against the bill, but were outvoted. They finally were able to obtain a division of the tax money between the State and the county from which the taxes were collected, the county's fifty per cent. of the taxes being in lieu of the tax money lost through automobiles being taken off the city and county tax rolls and placed only on the State tax rolls.

The city of Detroit brought suit to have the law declared unconstitutional, declaring that the city's tax rights were invaded by the State. Pending decision of this suit, the automobile owners of the State have been continuing, in many cases, to use the 1915 license tags, but it will now be necessary for all automobiles in the State to have the 1916 tags.

Through the money now made available by this automobile tax law, declared, as above stated, constitutional, Michigan will become one of the foremost States in the United States in highway construction. The legislature appropriated to the Highway Department the sum of $625,000, which is now available, for the year ending June 30, 1916. Up to the time that the decision was handed down, the State had collected about $1,136,000 from the sale of less than 100,000 automobile license tags, and since that date, applications for 1916 tags have been coming in at the rate of about 600 per day. All of this money, together with the approximately $1,136,000 which had been collected, will now be available. One-half of it will be turned over to the State Highway Department, and the remainder will be turned over to the county highway authorities. This money


Monarch Steam Road Roller With Scarifier Attachment.
*Found!*
A Scarifier that not only tears up the surface of worn stone roads, but **planes** the road as well. This scarifier is Simple, Durable, Easily Adjusted to any depth, and is Quickly and Easily folded up so that it does not interfere with the work of the roller.
**It Costs Little. It Does the Work.**
Write today for Catalogue of Rollers and Scarifiers. Furnished free.
THE GOOD ROADS MACHINERY COMPANY
KENNETT SQUARE, PENNSYLVANIA

can only be used in the construction and maintenance of highways. Secretary of State Vaughan stated that he is of the opinion that at least $2,000,000 will be received this year from the sale of automobile licenses; and, as the number of automobiles in Michigan is increasing rapidly every year, the State will have millions of dollars additional for the construction of roads in years to come.

* * *

## 146 Road Rollers Ordered by One Customer

One of the most remarkable events in the road-roller manufacturing business has just occurred in the purchase of 146 road rollers by the Russian Government from the Austin Mfg. Company, Chicago. This order is without doubt the largest ever placed in the history of road rollers, either in this country or any other country.

The heading for this article is perhaps modest in that it only refers to the orders placed in April, 1916. As a matter of fact, the Russian Government have owned and operated about fifty Austin rollers for a number of years. It can be attributed to the latter fact that this recent magnificent order has been placed with the same concern. The machines are ordered in three different sizes, eight-ton, ten-ton, and twelve-ton; they are equipped to operate on Russian kerosene oil, the product of the vast oil fields located in southern Russia.

The history of the Austin motor roller has been spectacular. Nine years ago they put their first machine on the market and probably no piece of machinery connected with engineering construction work has ever created so much excitement amongst competing manufacturers, or attracted so much attention from the road building public using road rollers.

* * *

## Annual Meeting of the Michigan Good Roads Association

(*Continued from page* 4)

nomical and more satisfactory in every way. His country, he stated, is a fruit country, and at certain times of the year the loads hauled are very heavy. Last year, the general practice of the farmers not living on good roads was to haul their wagon with three teams to the nearest good road They would then unhitch two of these teams and the remaining team would be able to easily haul the load to the market or shipping point. He concluded by saying that the farmers of his county have repeatedly said that were it not for their good system of macadam roads they could only have marketed a small fraction of their produce and crops.

The concluding paper of the morning was "Road Laws," by L. C. Smith, Deputy State Highway Commissioner, Lansing, Michigan. He told of many of the changes that have been made in the road laws of the State. One new law permits the State Highway Department to order grade separation at dangerous railroad crossings. Another increases the required strength of bridges to carry a live load of fifteen tons instead of ten tons. The law relating to the election of county commissioners moves the election from the spring to the fall, so that newly elected commissioners can take office in the winter and have time to familiarize themselves with their duties and to have time to plan and outline the work that will be done during the following summer. This plan is working out most advantageously to all concerned.

The remainder of the session was devoted to reports on what various counties in the State had done, and what they contemplated doing during the present construction season.

The closing session of the meeting was held Thursday afternoon, with State Highway Commissioner Frank F. Rogers as the principal speaker, on "The Selection of Types of Roads for a County Road System." In this talk, Mr. Rogers told of the progress that has been made in road construction in the State under his office.

Mr. Rogers said in part: "I do not care to tell you what kind of a road to build in your respective counties. But I would advise you to study your traffic conditions, study your soil on which you will have to build your roads, and study your materials which you propose using in the construction of your roads.

"I will say this, however, that sixty per cent. of the State reward roads that have been built in Michigan are gravel roads. And unless the traffic exceeds five hundred vehicles per day, I am not sure but that gravel will make the cheapest road. The average gravel road in Michigan costs about $2,000 per mile to build, while the concrete road road costs on the average about $15,000."

The closing paper of the meeting was a technical discussion of gravel and gravel roads by L. H. Neilsen, District Engineer of the Michigan State Highway Department. Mr. Neilsen was formerly engaged in road construction in the Philippines for the United States Government, and is recognized as one of the best road engineers and road builders in Michigan.

Mr. Colgrove formally closed the meeting with a short talk on his road construction experiences, and data on some roads that he had built many years ago which were still in service and in good condition.

The entire delegation that attended the meeting visited the Michigan-Detroit-Chicago Paved Way at Urbandale, where the first slab of concrete on the highway was laid for their especial benefit. Special cars were provided by the Chamber of Commerce, and shortly after the party arrived the mixer was started and the slab completed. Dirty gravel was used, however, and as it had been rejected by the State Highway Department, the slab was later removed. There was much interest manifested in the big Koehring Paver and in the Baker Finishing machine. The latter works across the entire surface of the roadway, giving a smooth surface that cannot be obtained by hand finishing.

THE EXHIBITORS

The exhibits were held in a large tent adjoining the Post Theatre, and attracted a great deal of attention, although many of them had not arrived in time to be set up. Included in those delayed en route was the exhibit of the

SAFETY FIRST
KYROCK
KENTUCKY NATURAL ROCK ASPHALT
THE COMING ROADWAY
The only Asphalt Surface furnishing a Safety tread for Horses and Autos. Why?
*Send for Booklet*
THE WADSWORTH STONE & PAVING CO. - - Pittsburgh, Pa.

TELL 'EM YOU SAW IT HERE.

Office of Public Roads and Rural Engineering, United States Department of Agriculture.

The State Highway Department had a large exhibit of road materials, laboratory testing apparatus, photographs, etc., in charge of J. J. Cox, Ann Arbor, Michigan.

The Barber Asphalt Paving Company showed moving pictures of the construction of bituminous roads by the mixing and penetration methods, and the producing and refining of Bermudez and Trinidad Liquid Lake Asphalts. The exhibit was in charge of R. J. Cummings, of the Chicago office of the company.

Peter Edwards, Sault Ste. Marie, Michigan, representing the Trap Rock Sales Company of the same city, exhibited and demonstrated an excellent grade of trap rock.

The Novo Engine Company exhibited two types of contractor's pumping outfits, both especially adaptable for supplying water in isolated sections for the construction of concrete and water-bound roads. Herman Loeffler, of the Lansing, Michigan, branch of the company was in charge of the exhibit.

The paving brick manufacturers had a number of representatives on hand at the exhibit. H. H. MacDonald represented the National Paving Brick Manufacturers' Association, of Cleveland, Ohio. John Laylin represented the Ohio Paving Brick Manufacturer's Association. A. B. Luten, Canton, Ohio, represented the Metropolitan Paving Brick Company. Frank Townsend represented the Dunn Wire-Cut Lug Brick Company, of Conneaut, Ohio.

J. H. Waters, of Detroit, representing the Wiard Plow Company, of Batavia, New York, exhibited a contractor's plow for use in tearing up gravel and macadam roads.

J. P. McHale, Galion, Ohio, and F. J. Babcock, Charlotte, Michigan, represented the Galion Iron Works Company, Galion, Ohio, manufacturers of every kind of road machinery and equipment.

The Beach Manufacturing Company, Charlotte, Michigan, manufacturers of road machinery of all kinds, rollers, drags, culverts, etc., was represented by Mr. Beach and F. H. Wells, both from the factory.


"HARRIS PAVERS"

Daily Capacity 40,000

THE HARRIS BRICK COMPANY

*Main Office* CINCINNATI, OHIO — *Factory* ZANESVILLE, OHIO

"Hydrolene"

Asphalt Products for Road Building are Unsurpassed

Road Binders, Asphaltic Cements, Road Oil

SUN COMPANY

Toledo, Ohio Philadelphia, Pa. Chicago, Ill.

PENNSYLVANIA PORTLAND CEMENT

"For Better Roads and Streets"

PENNSYLVANIA CEMENT COMPANY

30 East 42d Street NEW YORK

A. H. Blanchard

M. Am. Soc. C. E. M. Can. Soc. C. E

Consulting Highway Engineer

Broadway and 117th Street New York City

CHICAGO PAVING LABORATORY

LESTER KIRSCHBRAUN, Ch. E., Director

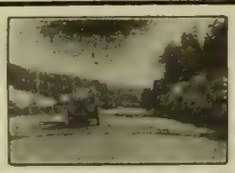
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Pavements and Paving Materials

160 N. FIFTH AVE., CHICAGO

Reports, Specifications, Plant, Street and Laboratory Inspection

Asphalts
Tars
Creosote Oils
Road Oils
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Petroleum



JAMES H. MAC DONALD

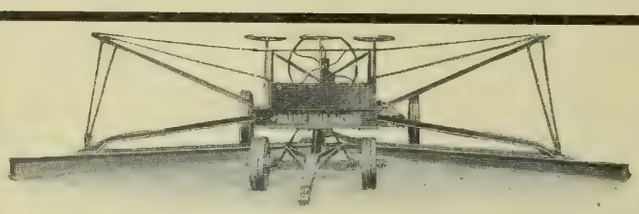
Consulting Road and Pavement Expert

Chamber of Commerce Bldg., NEW HAVEN, CONN

State Highway Commissioner of Connecticut nearly eighteen years.

Advice given on all phases of road building and street paving.

Consultations on specifications, materials and methods. Specialty of recommending efficient and economical equipment and plant. Accurate estimates for contractors.



SEVEN SIZES FRONT VIEW

JUMBO DOUBLE BAR ROAD MACHINE

SCRAPES 30 FEET WIDE IN ONE OPERATION

BUILDS 12 TO 20 MILES OF ROAD PER DAY

N. S. MONROE & SONS ESTABLISHED 1894 ARTHUR, ILLINOIS

APOLLO-KEYSTONE Galvanized Sheets

Made from KEYSTONE COPPER STEEL—Unequaled

FOR ROADWAY CULVERTS

as well as for Roofing, Siding, Flumes, Tanks, and all forms of exposed sheet metal work. Demand APOLLO-KEYSTONE for your Roadway Culverts. Look for the stencil—it insures greatest durability and resistance to rust. Accept no substitute. Write for our free booklet showing actual service tests.

AMERICAN SHEET AND TIN PLATE COMPANY, - - - General Offices: Frick Bldg., Pittsburgh, Pa.

TELL 'EM YOU SAW IT HERE.

## An Economical Roadway of Proven Success!

# BITOSLAG

## An Asphaltic Concrete Pavement Manufactured by Special Process in Which Pulverized Slag is the Principal Mineral Aggregate

In 1910 there was laid in McKeesport, Pa., an experimental pavement composed of a specially prepared asphalt and a mineral aggregate of finely crushed slag and a good proportion of the usual dust or "filler."

After five years' service under heavy traffic and without any maintenance cost whatever, this experimental section remained in an unblemished condition, and proved in the opinion of many engineers and paving experts a roadway that was durable, economical, non-slippery and a most practical and successful method of utilizing a waste product, and at the same time insure those features so essential to the modern highway.

This new and successful pavement, which has received the name of BITOSLAG, can be laid on old macadam, concrete, old brick pavement, rolled broken stone or slag foundation.

The detailed specifications for the BITOSLAG wearing surface to be laid on the various types of base mentioned will be furnished on request. Our laboratories and engineering experts will be pleased to give full information as to preparing the mixture properly and testing same from time to time. This service is free to public officials and contractors to assist them to secure the best possible pavement of this type.

***Correspondence Invited as to Licenses to Lay this Pavement***

## BITOSLAG PAVING COMPANY

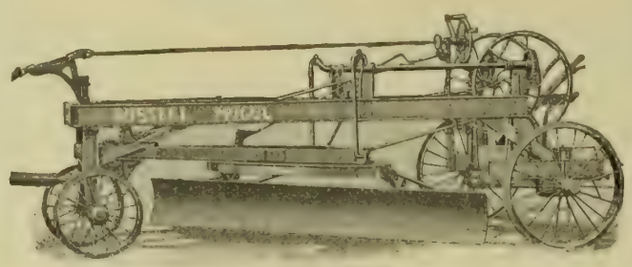
**90 West Street, New York, N. Y.**

# Russell Road Machines

## A Complete Line of Models For All Kinds of Road Work

Winners of the Gold Medal at San Francisco Exposition 1915. Road Machines for building and maintenance, Elevating Graders, Dump Wagons, Spreader Wagons, Scarifiers, Planers, Plows, Scrapers, Culverts, Steel Beam Bridges, Etc.

WRITE FOR BIG CATALOG.



### The Russell "MOGUL"

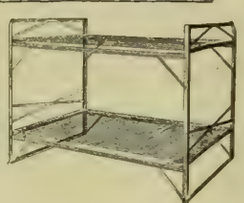
The largest, strongest road machine built. Has also the greatest capacity. Weighs 7,000 lbs. Blade 12 feet long, 20 inches wide. For tractor power only. A 60 H. P. tractor cannot overtax its strength. Complete, very simple adjustments. Does "wholesale" road grading most economically.

**RUSSELL GRADER MANUFACTURING CO.,**
MINNEAPOLIS, MINN.
Representatives In All Principal Cities.

# TIGER STEEL BUNKS



These comfortable, sanitary, steel bunks can be set up and taken down without the use of tools or bolts—just like an ordinary bedstead They are, however, equipped with a patented locking device, which makes a perfectly rigid frame. This insures a quick shift of camps. Gives your men clean, comfortable beds, which means much better work, and better men. Made in single or double decks in a wide range of sizes.



*Write Us for Particulars and Prices.*

**Send for booklet giving inside information on good camp equipment.**

**HAGGARD & MARCUSSON CO., 1119 W. 37th St., Chicago**

# READY TO ERECT BUILDINGS



Made in sections. Quickly put up and taken down. Unequalled for Tool Houses, Shelter Sheds, etc. Solidly built to stand hard usage. PEERLESS PORTABLE BUILDINGS, composed of Interchangeable Units, are weather, wind, and waterproof. Any sized building to your order. Simply tell us your requirements Prices right. Freight paid in North Central States.

**PEERLESS BUILDINGS CO., 500 E. 40th St., Chicago**


## A Strange Circumstance

Fifteen years ago, at the opening of the present century, the steam tractor had reached its fullest development, and steam tractors had become a common sight in all sections of the country doing the many kinds of work to which a tractor could be adapted.

During the last ten years of the nineteenth century, it had taken its place as one of the country's indispensable machines; and yet to-day it has totally disappeared, buried in oblivion, and none so poor to do it reverence.

Why? What drove it out of existence so suddenly? The gas engine. When the gasoline or kerosene motor had been fully developed and applied to a tractor, its complete superiority over the steam tractor was so obvious and was so quickly recognized, that the steam tractor simply faded away.

In a recent issue of the *Farm Implement News*, devoted to the tractor industry, there is given a Tractor Directory in which are listed alphabetically by name one hundred and forty-six tractors. Every one of them is a gas or motor tractor and there is not a steam tractor in the whole lot. Thus, in a few brief years it has been both killed and buried by its successful rival.

Everybody knows this is so. It is so much so that you never even see a steam tractor any more—a belated one sold years ago and still in operation. They have been as completely suppressed as though they had never existed.

There is only one modification to the above sweeping statement, and that is as it applies indirectly to the steam roller. A roller is nothing more nor less than a tractor with heavy wheels. The work required of it is exactly similar to that of any other kind of tractor, and there is not a single reason for abandoning the steam tractor in favor of the gas tractor that does not apply with equal force to abolishing the steam roller in favor of the motor roller; and yet, strange to say, while you cannot see a steam tractor any place, you can see more or less steam rollers which have still survived, and stranger even than that, some people are still buying them.

Ten years ago, there was not a motor roller in America. The first one built in this country was the Austin Motor Roller of the Austin-Western Road Manhinery Co. Since then, its sales, both actual and relative, have increased annually by leaps and bounds until to-day a very large percentage of all power rollers made in this country are motor rollers and probably ninety per cent. of the motor rollers are Austin rollers.

As an indication of the magnitude to which the Austin Motor Roller business has grown in a few years, the foreign and domestic sales of this roller alone during the single month of April were nearly two hundred, which is doubtless a larger number than the total sales of all other rollers made in America, both steam and gasoline, during the same period, and yet the strange fact remains, as stated above, that there are still some people so old fashioned and unimpressed by the march of progress that they still buy and use steam rollers. Not many, but some. Odd, isn't it?

Some might suppose that the answer this year would be found in the high price of gasoline; but that is not so, as gasoline would have to go very much higher than there is any possibility of it going to make an Austin Motor Roller cost as much for the operation as a steam roller, even when running on gasoline; but, as a matter of fact, the Austin rollers work equally as well with kerosene, distillate and other low-grade fuels costing but a slight percentage of the price of gasoline, and it is with such cheap fuels that the large majority of them are being used.

It is simply one of those strange circumstances that cannot be explained, why certain people do certain things, and in the absence of any other explanation we will have to let it go at that. For further information, address the Austin-Western Road Machinery Company, 910 Michigan Ave., Chicago, Ill.

# *One Foreign Government Bought*

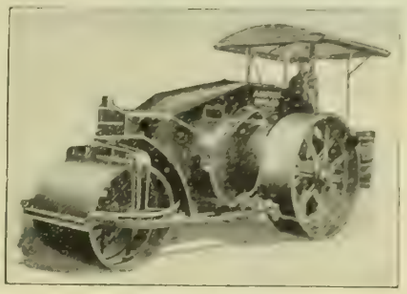
# *146*

# *Austin Motor Rollers Last Month*



Tandem Roller

*25 - - - 8-ton*
*74 - - - 10-ton*
*47 - - - 12-ton*



Macadam Roller

Not to destroy life, but to bind up the wounds of War.
The largest Roller order in History given for
The Highest Priced Roller.

## *Why?*

We are still taking prompt care of our home trade and will not let it suffer. No other Roller Company in America or elsewhere could handle a business of this magnitude.



Road Oiler

44 Rollers Shipped in Two Days.

That's what it means to do business with the Largest Road Machinery Plant in the World.



Jaw Rock Crusher

## The Austin-Western Road Machinery Co.

**Chicago, Illinois**

**New York Philadelphia San Francisco Syracuse Atlanta Los Angeles**
**St. Paul Jackson, Miss. Dallas**

*Austin Rollers Operate On Kerosene and Low-Grade Distillates*

## "Plymouth Gasoline Locomotive Is So Simple to Run," Says Fleigle, "My 8-Year-Old Son Handles It"

Frank Fleigle, brickmaker at Morrisonville, Ill., knows the Plymouth Gasoline Locomotive is "fool-proof," for Fleigle has proved it by letting his 8-year-old son run the one he installed more than a year ago.

Fleigle's son not only starts and stops it, but negotiates a 10 per cent. grade and handles the "Plymouth" with ease.



*From an Actual Photograph*

### "I Don't Need a Licensed Engineer with the Plymouth," Says Fleigle

"This elimination of gears and clutches makes the 'Plymouth' not only fool-proof, but solves my haulage problem, for your friction-drive locomotive is cheaper to run than feeding two horses, and think what I can do with it!"

### Plymouth Gasoline Locomotives Are Cheapest to Buy—Cheapest to Operate

The first cost of the Plymouth is less than any other industrial locomotive and it will do more work, last longer and perform its duty cheaper than any gasoline, electric, steam or compressed air locomotive on the market.

### An Easily Read Pamphlet—Yours for the Asking

Fleigle's full experience with the "Plymouth" and many others, showing actual cost and data, will be sent any one upon request. It is worth any one's time reading.

**THE J. D. FATE COMPANY**

213 RIGGS AVENUE - - - - - - PLYMOUTH, OHIO



PIONEER Highest Quality ASPHALTS

## An Expansion Joint of Quality

which meets National Paving Brick Specifications and all standard Specifications for Concrete Road Construction




Manufactured in any thickness or width desired. Neatly crated and shipped to the job ready to lay in one operation.

**The Pioneer Asphalt Co.**

Producers of Highest Quality Bituminous Products

LAWRENCEVILLE, ILL.

PIONEER Highest Quality ASPHALTS


TELL 'EM YOU SAW IT HERE.

The article on road work in Oklahoma, which appeared in the May issue of BETTER ROADS AND STREETS, states that a five hundred dollar bond issue was contemplated in LeFlore County, Oklahoma, for roads and bridges. This should have read five hundred thousand dollars, instead of five hundred.

* * *

The Southern Clay Manufacturing Company, Chattanooga, Tennessee, has purchased the Graves Paving Brick plant at North Birmingham, Alabama, and will at once begin making wire-cut lug brick at that plant. The Southern Clay Manufacturing Company has already plants at Robbins, Tennessee, and Coaldale, Alabama. The demand for this type of brick in the South has necessitated the purchase of the additional plant.

* * *

George W. Tillson, M. Am. Soc. C. E.; Henry G. Shirley, M. Am. Soc. C. E., and Arthur H. Blanchard, M. Am. Soc. C. E., a Commission of Engineers, appointed by the Wilmington Chamber of Commerce, have recently submitted a report on the administration, construction, and maintenance of highways which are under the jurisdiction of the Levy Court of New Castle County, Delaware.

* * *

The first four months of 1916 have broken all records in the Automobile Division of the Pennsylvania State Highway Department, the total receipts from the registration of motor cars, motor trucks, motorcycles and licensed drivers having been $1,666,615, or $1,338.50 more than the total receipts of the Department for 1915. There is little doubt but that the receipts for this year will exceed $2,000,000.

* * *

Roads are an excellent indication of the condition of the country through which they pass. If the country is stagnant and backward, poor and undeveloped, the roads will indicate this fact. If the roads are improved, well maintained and kept in repair, it is a certainty that the country is a prosperous one. But if there are no roads, we can just make up our minds that the country is worthless, that it is not inhabited, or that if it is inhabited, the natives are nothing more or less than savages.

* * *

In sections of the country where roads have been improved, the farmers are almost invariably found to be prosperous and community life has been developed to a high degree. But in sections where the roads have not been improved, the farms, the schools and the churches, as well as all other civilizing agencies will be found to be badly run down.

* * *

A recent issue of the Daily Consular and Trade Reports, published by the United States Department of Commerce, is authority that a new tract of asphalt and petroleum land in Venezuela will be developed at once. This tract consists of 494 acres, and is located near the city of Puerto Cabello. It has been leased by the Venezuelan Government to Guillermo Pimentel Troconis, and the contract stipulates that a specific sum shall be paid for each ton of product exploited by the contractor in addition to the amount paid for the use of the land. The contractor is also given the privilege, under the contract, to import such machinery as he may need, free of all duty, but that the machinery, so imported, shall, at the end of twenty-five years, become the property of the Venezuelan Government. It is also stipulated that during the period of exploitation, or the term of the contract, the Government shall be privileged to purchase such quantities of asphalt and petroleum products from the contractor as the Government may require, at a discount of twenty per cent. from the market price.

* * *

The Kelly-Springfield Road Roller Company, Springfield, Ohio, late in April received a contract from the French Government for twelve road rollers, ranging in size from four to ten tons. The contract calls for immediate delivery, and although it has not been definitely stated by the French engineer who visited the Springfield plant, it is thought these rollers will be used to repair and reconstruct the military roads behind the French line, all of which have been badly cut up by the enormous trains of motor trucks used in hauling supplies and ammunition to the troops in the trenches. The roads will then be maintained in the best possible condition in accordance with the well-known French road policy. At the conclusion

# The "Panama Line"



## *Hardin County Investigates Then Buys "Panamas"*

LIKE many friends who grow in favor as time elapses, "Panama Line" Road Machinery bears investigating and the closer its construction and operating principles are studied, the more they are seen to afford many valuable advantages.

That was the experience of Hardin County, Ohio, which has just purchased a large amount of equipment for building and maintaining its roads and streets.

After thoroughly investigating the various machines on the market, they found the "Panama Line" to embody more improvements and offer better value, dollar for dollar, than any other. As a result an order was placed for seven "Panama Giants" with patent scarifier attachments, weighing 5,000 pounds each, and one Boston Grader, weighing 1,000 pounds, also a number of "Panama" Drags. The photograph shows the equipment after being unloaded at Kenton, Ohio.

Hardin County's experience contains a "tip" for every one.

*Have you the "Panama Line" Catalog?*

MAIL OR USE FOR MEMORANDUM

The F. B. Zieg Mfg. Co. Fredericktown, Ohio

Gentlemen:-

Send your catalog as offered in Better Roads and Streets.

Name .....

Address .....

PANAMA LINE ROAD MACHINERY

THE F. B. ZIEG MFG. COMPANY

*Fredericktown, Ohio*

# WHEELING

## CORRUGATED METAL CULVERTS

## MADE OF PORTSMOUTH IRON

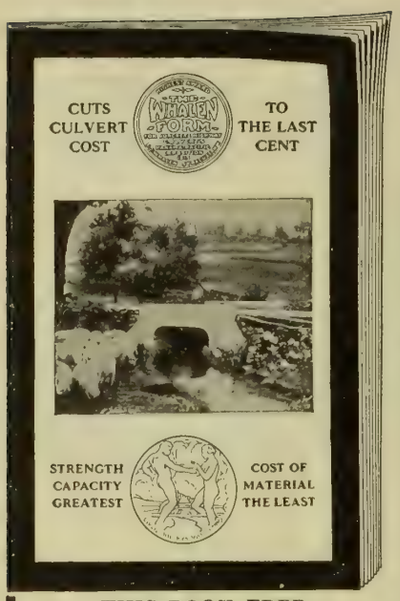
*Make Bad Roads Good*

WHEELING CORRUGATING COMPANY, WHEELING, W. VA.

BRANCH OFFICES AND STORES:

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| NEW YORK | CHICAGO | PHILADELPHIA |
| ST. LOUIS | KANSAS CITY | CHATTANOOGA |
| PORTSMOUTH | MINNEAPOLIS | RICHMOND |

SPECIFIED BY LEADING ENGINEERS




# PROOF!

YOU Road Builders are, or should be interested in culvert construction. The most vital question in road building today is, NOT what type of material to use for the surface of the road, or what make of machinery to do the work—but **the one biggest thing in all road construction is, or ought to be, Drainage!** How to get the most water across the road at the least expense and through the most permanent structure—is a question worthy of the best of you.

A NEW BOOK HAS BEEN WRITTEN ON CULVERT CONSTRUCTION. And this book is FREE to interested readers of Better Roads and Streets. The man who compiled the information contained in it probably knows more about this subject than any man in America today. Yet it is all given to you **free for the asking.** The only request is that you mention that you saw this ad in Better Roads and Streets The book does not confine itself to theories—but **is full of facts and figures.** Even if you do not agree with all that is written—tho that is not likely—you will still find the book full of intense human interest. **It will open your eyes**—if it does no more. This is **not** a catalog—it is a free BOOK on the subject of CULVERTS. A cut of the outside front cover is shown above. Now get busy with coupon below.

**THIS BOOK FREE**

SALESMEN WANTED FOR

## THE WHALEN FORM

**401 Vinney Building, Syracuse, New York**

**Use Coupon Below at Once and Get Your Copy of This Book Free Today.**

Fill out and mail today the Coupon below addressed to The Concrete Form Co., Inc., 401 Vinney Bldg., Syracuse, N. Y.

*Send me at once postpaid, and with no charge or obligation, a copy of your new Culvert Book*

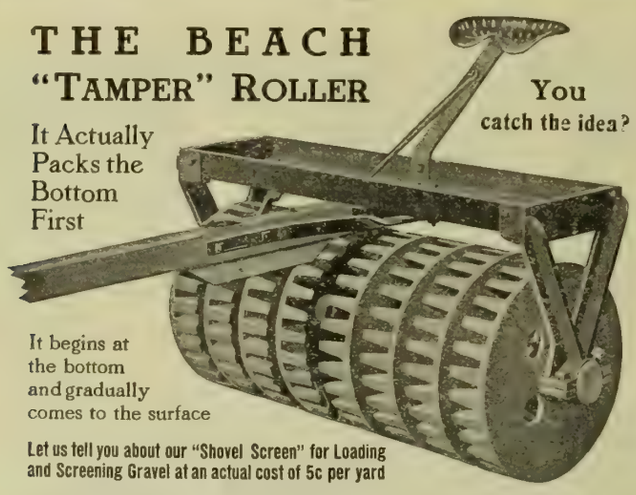
*Name*_____ *Business or Official Title* _____

*Address* _____

## THE BEACH "TAMPER" ROLLER

It Actually Packs the Bottom First

You catch the idea?



It begins at the bottom and gradually comes to the surface

Let us tell you about our "Shovel Screen" for Loading and Screening Gravel at an actual cost of 5c per yard

**Beach Mfg. Co., 30 Beach St., Charlotte, Mich.**

## NATIONAL MAP SHOP

MODERN MAPS DESIGNED FOR REPRODUCTION

WASHINGTON

COMPILING-DESIGNING DRAWING-PRINTING-ENGRAVING



**Attractive maps talk! If you want YOUR map, plat or diagram to get an AUDIENCE, you can't afford to overlook this point. Tell us what you want and let us give estimates and samples. ROAD MAPS FOR BLUE PRINTS OR LINE CUTS A SPECIALTY**


of the war they will be used again in generally overhauling and reconstructing the thousands of miles of roads that will need such attention. The rollers will be shipped to New York City crated for export, and will be sent across on the first available steamers. This is the second large contract which has been received by the Kelly-Springfield Roller Company from the Allies, a similar contract having been placed about five months ago by the Russian Government, ten rollers having been purchased in this case also, all of which were shipped a few weeks after the contract was awarded. All of the rollers to be shipped to France will be of the most improved types.

* * *

## Etnyre's Four Distinct Lines

A small circular recently has been issued by E. D. Etnyre & Co., Oregon, Ill., illustrating their four distinct lines of road and street machinery. These are: 1. Horse-drawn power flushers; 2, motor-driven power flushers; 3, pressure oil distributors; and 4, street sprinklers. However, combination machines are built in many instances being in considerable demand by medium-sized cities.



Large Motor Flusher equipped with 960-gallon tank recently purchased by the city of Vicksburg, Miss., shown in operation last month. Federal Chassis.

The oiler is shown equipped with the Etnyre combination valve distributor which allows oil to be sprayed so that it will cover any width from two to thirty feet in one operation. This valve has now been on the market a little less than a year, but has proved very popular.

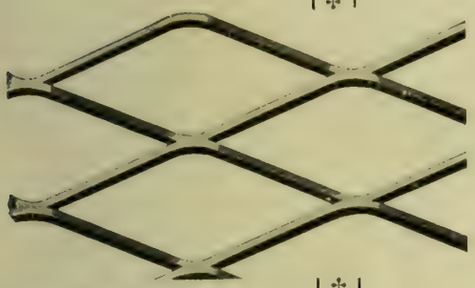
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## Mountain Road Concession in Peru

The Peruvian government has granted a concession to Adolfo Hilfiker, a civil engineer, for the construction of a pack road between the station of Urcos, on the Juliaca-Cuzco Railway, and a navigable point on the River Querene or the River Madre de Dios. The terms of the contract, published in El Peruano of February 4, reveal the many difficulties in the way of transportation in this mountainous region of Peru. The road, which will be approximately 125 miles long and eight feet wide, will pass through native forests in which ample spaces must be cleared. Where swamps are encountered, they must be drained and the roadway laid with stone. Where streams are to be crossed, strong bridges must be built or rafts and canoes provided.

In connection with the road, the concessionaire agrees to construct way stations or road houses every fifteen miles, where carriers and freight may be protected from the mountain storms. Freight in transit may be stored at these stations without charge for ten-day periods or less. A telegraph and a telephone line must also be installed along the road, and electric communication must be furnished free to the government. No toll will be collected for the use of the road. The concessionaire agrees to keep the road in good condition for thirty years, and at the end of this time to turn it over to the government of Peru. In consideration of these various services, the government grants to the concessionaire the absolute

# True Reinforcement and Perfect Joint Protection



Kahn Road Mesh



Kahn Armor Plates

The construction of a Permanent Concrete Road requires reinforcement to take care of the heavy stress brought upon it owing to the inequality of the sub soil. The expansion joints need protection in order to save the edges of the concrete next to the joint.

## Kahn Road Mesh

Kahn Road Mesh is a strong, rigid reinforcing, manufactured from one piece metal plates. It is shipped in large flat sheets, that, when once placed, cannot be jarred from position.

It eliminates the unrolling of coils, cutting to length and tying into position.

Kahn Mesh will fulfill all specifications and help materially to make your concrete road a better one.

## Kahn Armor Plate

Kahn Beveled Edge Armor Plates eliminate the possibility of the pavement chipping or cracking at the expansion joint.

The beveled edge (an exclusive feature) does away with the square corner of the concrete next to the plate and this with the split-end prongs provides a solid anchorage that no jarring nor traffic can loosen.

## Trussed Concrete Steel Co.

Department A-57 YOUNGSTOWN, OHIO

REPRESENTATIVES IN PRINCIPAL CITIES

KAHN Building Products TRUSSED CONCRETE STEEL CO.

# "Armco" Iron Corrugated Culverts



## For Adaptability, Efficiency and Long Service

They are adapted to the rural earth road and to the city boulevard. Their corrugated form and overlapping joints confer ample strength together with a resiliency or **toughness** which enables them to stand more grief and hard luck than anything else in the form of a culvert. And their material is the **purest,** most **even** and most **durable** of irons.

*For full information on "Armco" (American Ingot) Iron Culverts, Siphons, Flumes, Sheets, Roofing and Formed Products, write to*

**Armco Iron Culvert Manufacturers' Association,** Cincinnati, Ohio

AMERICAN ARMCO INGOT IRON

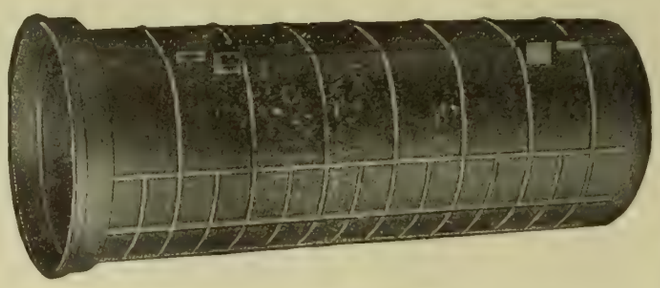
ARMCO IRON

the product of The American Rolling Mill Co. is the standard for Purity and Rust-Resistance

# SAVE TIME—SAVE MONEY

USE THE

## Burch Expansion Cast Iron Culvert Pipe



8 to 48 inches diameter, 3 and 4 ft. lengths. Half sections which lock with lugs.

Provides for expansion and contraction. Easy to handle and lay in ditch. Requires less excavation. Strong and durable. Send for Catalog "F" giving full description of complete line.

## THE BURCH PLOW WORKS CO.

CRESTLINE, OHIO



## Kerosene Power Cheapest for Road Work



How much more money would you make for yourself or for your community if you found a way to cut 25 per cent. off your present cost of grading roads? If you are still using horse or mule power, we can show you a way to save even more than that. If you are using a gasoline tractor, we can still show you how to make a profitable saving.

Every dollar you cut the cost of road grading is a dollar added to your net profit. We can put you in touch with one man who says he cut the cost of road grading in Louisiana from $26.00 PER MILE with mule power to $4.50 PER MILE with MOGUL kerosene tractor power. His figures are in the official records of his parish.

That is probably an extreme case, but the fact that so large a saving as this could be made, is interesting. It suggests that possibly your costs are higher than they need be. Perhaps a little investigation would pay. Would you like to see some of the figures we have collected—some of the savings we have helped other contractors and road builders to make by changing over to MOGUL or TITAN kerosene tractor power? They'll cost nothing but a two cent stamp and a little time. Write for them.

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ownership of 1,000 hectares (2,471 acres) of mountain land for every kilometer (0.62 miles) of road constructed, or a total of nearly 500,000 acres. In addition, the government agrees to grant no concession for competing roads within fifteen years. The concessionaire must present preliminary plans within ninety days, and must complete the road within four years from the date of concession.—(*U. S. Commerce Report.*)

* * *

## Hardin County Boosts Good Roads

Never before in the history of the good roads movement has there been so much activity for good as is manifested at the present time. This activity is general and widespread, but frequently a county puts forth such efforts as to be worthy of more than passing interest.

This is particularly true of Hardin County at present, which has just purchased seven graders of the 5,000 pound type and one of the 1,000 pound type, as well as a large assortment of drags.

The complete order was furnished by the F. B. Zieg Manufacturing Company, of Fredericktown, Ohio, manufacturers of well-known "Panama Line" road machinery. The seven large machines are "Panama Giants" and the small one a "Boston" grader, while the drags are of assorted weights and types.



The photograph shows the shipment immediately after being unloaded at Kenton, Ohio, by Glenn Brothers, Kenton agents for the "Panama Line." At the tongue of the light grader is Mr. Thomas Derickson, General Manager of the F. B. Zieg Manufacturing Company (with derby), and Mr. Bixler, Vice President of the Ohio Good Roads Federation, while the gentlemen seated and apparently "wearing a smile that wont come off" is Walter Johnson, President of the Hardin County Automobile Association.

Possessed of this complete high grade equipment and the progressive spirit as manifested in its purchase, Hardin County is destined, in the near future, to have ideal roads and increased prosperity which is the sure and deserving reward.

* * *

## Use of Electric Trucks

Four highly interesting papers were presented before a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Sections of the Electrical Vehicle Association and the American Institute of Electrical Engineers on March 27, 1916, as follows:

1. "Automobile Motor Characteristics," by F. A. Putt of the General Electric Company.
2. "Accomplishments of the Electric Passenger Car," by Gaid Reed of the Walker Vehicle Company, Chicago.
3. "The Electrical Commercial Vehicle," by W. J. McDowell of the General Motors Company, Pontiac, Michigan.
4. "Storage Battery Industrial Trucks and Tractors," by W. F. Hebard of the Buda Company, Chicago.

Of most interest to municipal engineers were the last two. Mr. McDowell's paper dealt largely with the field of the electric truck.

In substance, it was stated that electric trucks should be used where starts and stops are frequent, such as, for example, in the collection of ashes and refuse where stops have to be made at each house. Good pavements are essential to electric

truck operation, and these two facts make the electric essentially a city vehicle.

Fifty miles per day is about the practical limit of electric truck operation; one charging of the batteries is not sufficient for much more than this distance.

Of more interest, however, is the lower limit set for economical operation. A case was cited in which, for a day's run of only nine miles, an electric truck proved more economical than a horse and wagon. For runs of from twelve to fifteen miles and greater, the electric will practically always show the less cost.

The most interesting record spoken of during the evening was that of a truck which made 44 miles in a day of 11 hours making 358 stops and nearly 500 deliveries.

Mr. Hebard's paper brought out the fact that ordinarily, the small industrial trucks will return their purchase price to the investor within seven to eight months.

* * *

It is not generally known in the highway realm and among those interested in highway work that Clinton Cowen, State Highway Commission of Ohio, is considered quite a specialist and expert in archaeology, but this is a fact, nevertheless. Mr. Cowen has explored and surveyed many dozens of the prehistoric Indiana mounds in Ohio and the remains of the homes of the Indians and Cliff Dwellers of Colorado. He has, at his home, a valuable and cherished collection of Indian relics, including implements of hunting and warfare, domestic utensils, articles of clothing and ornament, and primitive writing materials.

In 1888, when Harvard University wanted a model of the famous serpent mound in Adams County, Ohio, the authorities of that University secured Clinton Cowen, then a young civil engineer of Hamilton County Ohio, to make it. Mr. Cowen was also employed in 1892 by the Commissioners of the Chicago World's Fair to make the models of the famous Indiana mounds found in such numbers in the lower part of the Miami Valley, Ohio.

* * *

## A Low Water Concrete Bridge

Half way between Shelbyville and Wartrace, in Bedford County, Tennessee, is situated the bridge represented by this photo. As the name implies, the low water passes through the ten arches in this bridge, and the very high water runs over it. The top is dry for eleven and a half months in the year, and for only a day or two is it past fording, and then usually the water is backed up from Duck River.

The arches are semi-circles eighteen to twenty-four inches high, and thirty inches wide, and the concrete is five inches at top arch. It is fourteen feet wide and sixty feet long, and was built across Butler's Creek in November, 1915, at an expense of only $175.



As you can see from the photo, the bottom of this creek is very rough and the auto had bad crossing, but now they can cross at any speed desired.

Also can be seen a large post at far corner of bridge which is one of the four posts which sustain two large wires running in line with the each edge of the bridge and about ten to twelve feet high. From each of these high wires five wires are suspended to guide the traveler when the bridge is covered with water.

Beginning at the left, first is seen B. R. Whitthorne, Esq., second Mr. J. E. Shoffner, President of the Shelbyville Turn-




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Thousands of dollars are being spent annually to promote Brick and Concrete Roads, BUT BEAR IN MIND THAT A BRICK ROAD COSTS MORE THAN TWICE AS MUCH AS MACADAM and Concrete increases the cost nearly one-half and neither will wear any longer than a high standard Macadam Road.

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pike, third Mr. J. C. Crawford, and the one on the right C. L. Shoffner, General Manager of the Shelbyville Turnpike, and the designer and builder of this kind of bridge, this being the third one built in ten miles of pike.

* * *

## Farmers Interested in Transcontinental Highways

During the next decade, no problem will absorb the attention of the American people to a greater degree than the road question. During this period, some definite, equitable plan will have been worked out, if not actually completed, for a system of national highways. This is the direction toward which the roads movement is drifting—a system of national highways will mark the climax of the movement.

Our Government has plenty of money to build permanent highways in Porto Rico and the Philippine Islands. Congress can appropriate annually millions of dollars for rivers and harbors. We have been spending from two hundred millions to three hundred million dollars annually for the army and navy; and all this without protest from the American people.

Why not an appropriation for national highways—something that will touch the every-day life of the average American citizen every day in the year, in every section of the country in all the future years? The proposition is so just and fair, the suggestion so plausible, and the benefits so apparent that no political party or no American Congress can refuse to heed public sentiment upon the good roads question.

The same appropriation that Congress has been granting for rivers and harbors, to benefit a few people, will build two trans-continental highways every year from New York to San Francisco, which will benefit many people.

It does not take much of a prophetic vision to see the coming of a system of national highways which will serve the needs of the people and at the same time stimulate a corresponding interest in State and county highways until a network of good roads covers the country from one end to the other.

It is said we move about fifty billion tons annually one mile over dirt roads in the United States; that it costs about ten cents per ton mile over a good road and about thirty cents per ton mile over an ordinary dirt road. The annual financial loss due to the transportation of crops over bad roads is estimated at two hundred and fifty million dollars.

This is where the farmer comes in on the good roads movement. This is also where my subject, "Value of Trans-continental Highways to the Farmers," comes in.

The farmer's problem is the marketing of his crops as economically as possible, the saving of time in the marketing of his crops, road conditions that will permit the marketing of the crops when they should be marketed, and the increase in the value of every acre of land adjoining or adjacent to a good road.

It costs the wheat grower nearly two cents per bushel more to haul his crop nine and one-half miles—the average haul—to the railroad station, than is charged for freighting it from New York to Liverpool, three thousand miles. The mud tax in this country, so-called, has been figured out to be six cents per bushel on wheat, which is a toll that comes out of the pockets of the farmer, and the problem of his marketing his crops when road conditions are good, regardless of the market, is another toll which comes out of the pockets of the farmer.

There is also another side to the good roads movement. It is the part played in the rural school. Statistics show that in five States having the best roads, seventy-eight pupils out of one hundred attend school, while in five States having poor roads, fifty-seven pupils out of one hundred attend school. So it is demonstrated that good schools and good roads go hand in hand.

* * *

The time has come when we must have good roads whether we want them or not. If we do not want them we will be left behind in the march of progress.

* * *

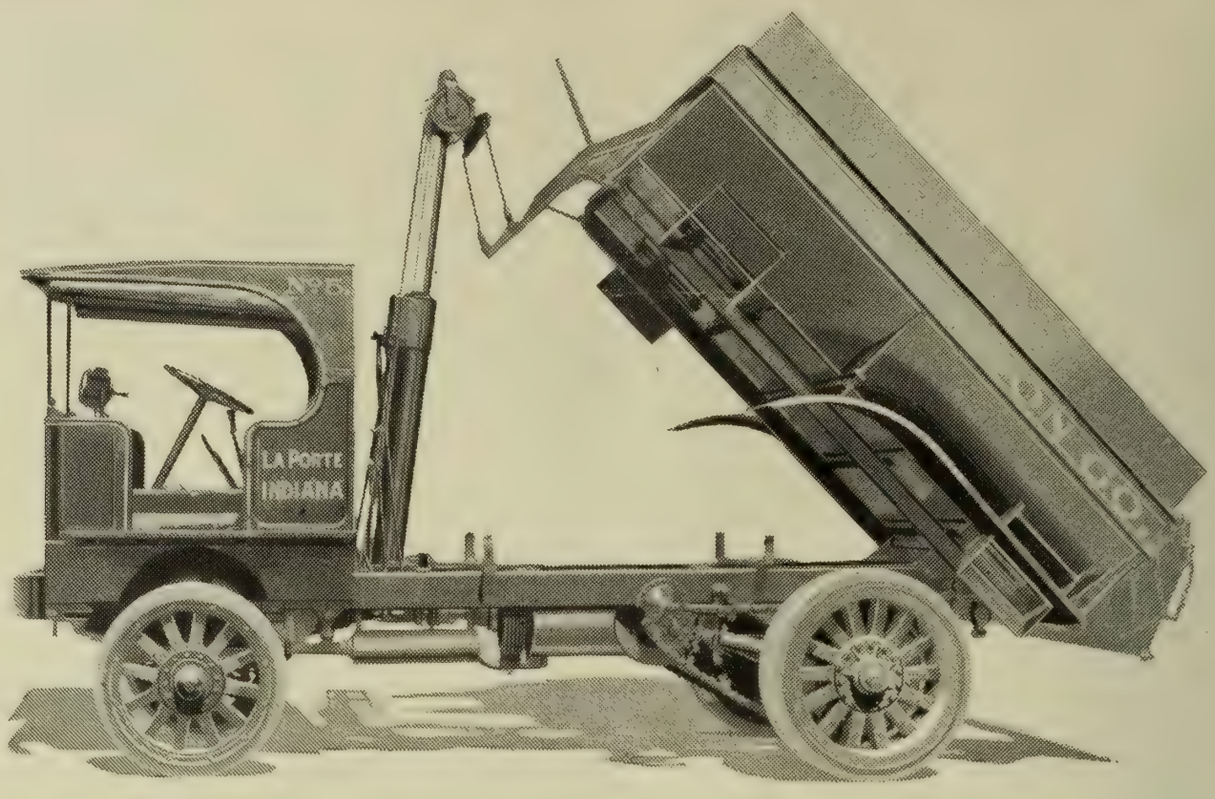
Those that will MUST. It may be unpleasant to make good roads for a lot of ingrates, but there is now no other way. The time never was, and probably never will be, when everybody will be ready to help and tote his share of the load.

25.05
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# BETTER ROADS AND STREETS



JULY, 1916.




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Necessarily the decisions of such firms are based solely on the solid evidence of superiority.

The following letter from the T. G. Hamilton Company of La Porte, Indiana, shows the remarkable economy with which they are operating the two Garford trucks in their service:

**"We are pleased to submit the following results obtained with the operation of our Garford trucks, engaged upon highway construction in La Porte County, Indiana, during the past season, and based upon the yard mile and ton mile of stone hauled over earth roads.**

| | Yard Mile | Ton Mile |
|---|---|---|
| **Gasoline** | **0.18 Gal.** | **0.144 Gal.** |
| **Oil** | **0.0038 "** | **0.003 "** |
| **Cup Grease** | **0.017 Lbs.** | **0.0136 Lbs.** |

**"These figures are deduced from the total amount of stone hauled, the total amount of gas and oil used, and the distance between the loading point and dumping point, and therefore include the gas and oil required by the round trip."**

The Hamilton Company is one of many road building companies operating Garford motor trucks with great success in all sections of the country.

There is also a Garford for **you.** We can supply you with a Garford motor truck of the proper size, style and power to do your work dependably and economically.

See the nearest Garford dealer or write today for information. Please address Dept. 100.

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## The Garford Motor Truck Co., Lima, Ohio

**Manufacturers of Motor Trucks of 1, 1½, 2, 3½, 5 and 6-ton capacity.**

# Better Roads and Streets

VOL. VI. NO. 7 JULY, 1916 PRICE FIFTEEN CENTS

# The Seventh Annual Conference of Mayors and Other City Officials of the State of New York

THE Seventh Annual Conference of Mayors and Other City Officials of the State of New York was held at the Onondaga Hotel, Syracuse, New York, May 31 and June 1 and 2, and both from the standpoint of attendance and the importance of the papers read and the municipal questions discussed, was the most important and most successful that this organization has ever held. Contrary to the case last year, there was little time devoted to papers on subjects directly relating to paving and paving construction, but more time was devoted to the subjects of city health, unit cost accounting, sewage disposal, the securing of accurate municipal data, taking care of the unemployed, methods of taxation, uniform bond laws, the collection of city revenue, standard units for comparing municipal improvements, etc.

The organization is the most important organization of city officials in the entire country, and in the seven years of its existence has accomplished wonders in establishing standards for improved city and city department government.

The Conference of Mayors and Other City Officials of the cities of New York State meets annually to discuss and to recommend improvements in city government and possible solutions of municipal problems, with the idea that the officials may receive suggestions that will be beneficial to them and to their constituents. The work of the conference is carried on throughout the year by the officers, committees, and the State Bureau of Municipal Information.

Efficient city government is the goal sought by every city in New York State. The conference aims, through its State Bureau of Municipal Information and by means of its annual meetings, to assist each administration to give the maximum amount of efficient service by bringing together the officials and experts of known ability, to give the officials of different cities an opportunity to exchange views on the leading problems of the day and to make it possible for the cities of the State to work as a united force for or against legislation affecting the well-being of urban population. It endeavors, also, through the press and by means of printed reports and its proceedings, to give to the public the latest and best thoughts on municipal government, for the purpose of stimulating and fostering interest in public affairs and co-operation between the public officials and their constituents.

An idea of the importance that is attached to these meetings may be had from the fact that this year there was at least one city official present from every city in the State of New York. All of the sessions, which were of a strictly technical nature, were well attended, and more than a score of papers dealing with all phases of the problems of city government, city finances, and public improvements, were read and discussed. Little time was set aside for recreation, a smoker tendered by the city of Syracuse following the session on Wednesday evening, and a shore dinner following the adjournment on Friday afternoon having been the only events of this nature.

On Wednesday afternoon, following a number of interesting addresses by city and society officials, the Hon. Francis M. Hugo, Secretary of State of New York, addressed the convention. In the evening of the same day, Mayor Harry N. Hoffman, of Elmira, presented the report of the Committee on Reducing a City's Army of Unemployed, recommending that all cities so regulate their public works improvements that, while private employers are operating on reduced bases, the cities would be able to extend their public works and thereby keep the number of unemployed down to a minimum.

Mayor James T. Lennon, of Yonkers, presented a comprehensive review of the work that has been done by the Information Bureau of the council, through which the cities of the State co-operate to secure reliable and up-to-date municipal data, and in conclusion stated that the success of the bureau has been much greater than had been anticipated or even hoped.

The Thursday-morning session was devoted to subjects on sewage and health, the speakers urging uniformity in municipal health budgets and the keeping of separate cost accounts of the several functions that are under municipal health control. It was urged that all matters affecting health in any degree, including garbage collection and street cleaning, be placed under the jurisdiction of health boards. The opinion of the speakers in this respect was not concurred in by the officials present, however.

At the Thursday-afternoon session, President Martin Saxe, of the State Tax Commission, speaking on "Exemptions of Real and Personal Property from Taxation," made a violent attack on the organized methods by which a large number of corporations evade the payment of taxes, thus throwing the burden of taxes on the small home owner. He declared that the duty and purpose of the Tax Commission to tax personal as well as real property, is right and should be given every support. He closed his talk with the statement that if taxes were paid on exempt realty, the yield would be sufficient to run the entire State government.

On Friday, one of the most interesting papers of the meeting was presented by A. Prescott Folwell, chairman of the Committee on Standard Forms of the American Society of Municipal Improvements. This paper being of interest to those identified with street paving, an abstract of it is given herewith.

## STANDARD UNITS FOR PAVING AND SEWAGE

To the majority of city officials and taxpayers, the one thing most readily understood about public work is its cost. Even engineers, to whom the technical and construction sides are those of most interest, must also consider cost, and consider it most carefully; not only because the closeness of agreement between their estimates and the actual cost is taken by many citizens as a measure of their ability, but much more because of the real practical importance of such close approximation.

The importance of close estimating is very apparent. If an estimate is excessively high, it may cause the voters to defeat a proposed improvement at the polls. If it proves to have been too low, the voters will be suspicious of all future estimates and may for that reason reject future improvements. All bond issues based upon low estimates place the city administration in an embarrassing position.

Estimates must be based upon the cost of past work. I know of no other reliable method of estimating. This means that we must have exact knowledge not only of how much was spent, but also of what was obtained for it. UNIT costs are necessary for making estimates.

The cost of public work is one thing which any taxpayer feels that he can understand, however hazy his ideas may be concerning the engineering features. When, therefore, he learns that some other city is getting a certain kind of pavement at considerably less cost than his own, or that he is assessed more per foot front for a pavement laid on his street than his neighbor is for the same kind of pavement laid on another street in his city, he wants to know why, and is entitled to a clear and definite answer.

There always is an answer, and it is generally a perfectly valid one; but the mere fact that explanations and excuses are necessary is apt to arouse suspicion, especially if there is anything indefinite about the explanations given. How much better if explanations were unnecessary; or if, when required, they could be made so clear and concise as to convince any man of average intelligence.

That taxpayers in many cities have reasons for asking such questions, and that the data obtainable in such cities is not at all adequate as a basis for the preparation of reliable estimates, are illustrated by the accompanying table. In reply to inquiries made this year and last, several hundred city engineers furnished figures giving the average costs to their cities of each of the various types of pavement. From the figures furnished for New York State, I have selected those shown in the accompanying table. Figures equally remarkable could be cited for a dozen other States.

COST OF PAVING IN SOME NEW YORK CITIES

*Brick Paving*

| | 1915 | 1914 |
|---|---|---|
| Dunkirk | $1.39 | .... |
| Jamestown | 1.62 | $1.62 |
| Plattsburg | 1.65 | 1.65 |
| Olean | 1.85 | 1.75 |
| Salamanca | 1.89 | 2.25 |
| Corning | 2.00 | 2.04 |
| Hornell | 2.10 | 2.03 |
| Albany | 2.11 | 2.04 |
| Binghamton | 2.19 | 1.98 |
| Lockport | 2.30 | 2.25 |
| Little Falls | 2.30 | 2.65 |
| Elmira | 2.32 | 2.32 |
| Oswego | 2.35 | 2.43 |
| Utica | 2.35 | 2.36 |
| Syracuse | 2.37 | 2.05 |
| Port Jervis | 2.45 | 2.46 |
| Niagara Falls | 2.50 | 2.62 |
| Auburn | 2.75 | 2.45 |
| Troy | 2.85 | 2.73 |
| Buffalo | .... | 3.29 |
| Average, not including Buffalo | 2.21 | 2.21 |
| Maximum | 2.85 | 2.73 |
| Minimum | 1.39 | 1.62 |

*Sheet Asphalt Paving*

| | 1915 | 1914 |
|---|---|---|
| Geneva | $1.25 | .... |
| Schenectady | 1.49 | $2.00 |
| New York City | 1.68 | 1.53 |
| Albany | 1.74 | 2.14 |
| Syracuse | 1.99 | 1.87 |
| Troy | 2.23 | 2.45 |
| Buffalo | .... | 3.53 |
| Average, not including Buffalo | 1.73 | 1.99 |

Take sheet asphalt, for instance. The method of constructing this is standard, and there should be no great difference between the costs of it in several cities in the same section of the country. But in 1915, this pavement cost Geneva $1.25 per square yard and Troy $2.23 per square yard. It looks as though the Troy taxpayers have some explanation coming to them.

Syracuse paid $1.87 in 1914 and $1.99 in 1915—an increase of twelve cents; but Albany paid $2.14 in 1914 and only $1.74 in 1915—a decrease of forty cents. What is Syracuse's explanation?

Or take brick pavements: In 1915, Dunkirk laid these for $1.39 per square yard, while Troy paid $2.85—more than twice as much. Syracuse paid $2.05 in 1914 and $2.37 in 1915—an increase of thirty-two cents; while Salamanca paid thirty-six cents less in 1915 than in 1914, or $1.89 as compared with $2.25. I have no figures for Buffalo for 1915, but she reported for 1914 a cost of $3.29 for brick pavement—nearly two and one-half times as much as Dunkirk—and $3.53 for sheet asphalt, or nearly three times as much as Geneva.

## WHAT IS "PAVING"?

One thing is sure, there was not actually all this difference in cost; and it is evident that these figures are for some reason not comparable, that the thing which Buffalo calls paving is not the same as that to which Dunkirk applies that name; and what Syracuse did for $2.05 in 1914 was not, I believe, the same as that for which she paid $2.37 in 1915.

As Buffalo is the most "horrid example," let us see what she paid $3.53 for in 1914. It included, besides the pavement, some grading, setting new curb, laying a drain, probably other general work like resetting manhole heads, and a ten-year guarantee. Another city, not in this State, has gone far ahead of this. however, for she includes under the head and price of paving, all excavation, curb, storm sewers, adjusting of manhole heads, building catchbasins, and even grading the private property along the street. I see no reason why that city did not include lighting standards, wire conduits, shade trees, and other street accessories, except that they perhaps were already in.

All these things are street improvements, but they are not paving, and to call them so seems absurd.

Moreover, to explain that a certain cost includes grading and setting curb does not help us to compare this cost with another; it only shows that such comparison would be useless, unless we know just what part of the cost was to cover each of these non-paving items.

The total cost of these non-paving items may be considerable. For instance, in 1915, Walden, N. Y., laid a brick pavement which cost $1.84 per square yard for the pavement and foundation, but $2.34 if excavation and other improvements were included. This is an average and not an extreme case. In some cases the additional items will amount to even more than the paving.

It may be claimed by some cities that under their methods of assessment the property owner is to be assessed for the total cost of the improvement, and therefore that this is the cost desired. This is all right, if you call this "street improvement" and not paving; but even in this case itemizing costs would be of great value, and if the cost were itemized a school boy could get the total cost per foot front in five minutes by a little multiplication and addition; while if the bids or record give only the total cost, not even a paving expert can "unscramble the eggs" and tell what the paving alone cost.

Some prefer a "lump sum" bid, so that no extras can be worked in on the payment; but the same end can be reached by receiving itemized bids and adding a "residuary item" clause, asking a price for all work necessary to complete the job according to plans and specifications, but not covered by the other items.

## ITEMIZING BIDS AND COSTS

The advantage of having bids or costs for each item is, we think, apparent with a moment's thought. If we know what it costs each city in the State or in the country to lay a square yard of standard brick pavement, exclusive of excavation, curbs, or any other items, then we have figures which are directly comparable. We can tell whether neighboring cities really did get more for a dollar then we did. We can show the taxpayers, without dubious explanations, that they are getting more for their money this year than they did last year. If *A* complains that his street improvement assessment is higher than that of *B* who lives on the next street, we can show him that it is because there was more grading to be done on his street or more curb to be set, and that the paving itself does not cost him a cent more. The probability is, however, that the facts will appear so plainly in the published figures that we will not need to explain it at all.

In the previous remarks, paving has been used for illustration, but the same ideas apply to sewer construction or to any other kind of public work. It is only when costs are itemized that cost records of such work will be of value for making future estimates, or comparisons with costs of previous years or of other cities.

Such itemizing is essential for obtaining efficiency and economy. How can we expect to cut down costs if we do not know which items are the high ones? Can a manufacturer know how to increase his profits if his accounts show, not what individual items cost him to produce and market, but only his total profit or loss for the year?

## STANDARD UNITS

If the only aim is to compare costs in your own city and on work done by you individually, then each might select his own units for measuring and expressing quantities of work; but how much more valuable each one's cost records would be if he could compare them with those of other cities and of previous administrations in his own city. This means that he and all others should use the same units; that when he says a

(*Continued on page* 44.)

# Limitations of Tests which Define the Essential Properties of Stone Block, Paving Brick, Wood Block, and Cement Concrete when used in Pavements

TESTS of the materials proposed for use in the construction of almost any pavement are now generally accepted as advisable, and in fact necessary, before the material shall be determined upon for use. They are made for at least three purposes: first, to identify the material; second, to prevent the substitution of a material similar perhaps in some ways but yet essentially different from that prescribed for delivery; and third, to assist in determining the suitability of a material to meet satisfactorily the conditions known to exist or presumed likely to exist. A fourth reason for testing or analyzing the material may be in order to accumulate information tending to clarify points still undetermined.

Almost all tests are based on actual experience with the material, and have some relation therefore to the use to which it has been, or is to be, put, but most of the tests of highway materials have been developed in recent years and many of them are to-day not finally crystallized. Some will not be perfected until the knowledge of highway materials, and in fact the science of highway engineering, has a wider basis than it has now, nor until the changes in traffic conditions shall be less violent than those at present prevailing.

Not so many years ago, it was a common practice in engineering work in general to select and to accept materials for the work on the basis of comparison, through the personal judgment of the authority in charge, of the materials proposed or offered, with certain other material more or less definitely described by trade or other names, whose use had previously given, in the opinion of the authority in question, satisfactory results. For instance, as late as 1895, cement frequently was specified to be "Hoffman Rosendale cement, or other brand equally good in the opinion of the engineer," and a few years later, a similar clause in specifications was frequently to be found regarding "Saylor's Portland" cement. Not until the last two or three years has a clause like "Bermudez Asphalt, or other brand equally good in the opinion of the engineer," disappeared from specifications.

The opportunities for argument as to the identity of the material, as to its comparison in value, with the specific material mentioned, to say nothing of the opportunities and even inducement for the advancement of improper arguments which influence the judgment of the engineer under such a clause as mentioned, are and were apparent to all. The more progressive engineers appreciated the necessity, for the sake of the profession as well as for the sake of results in the work, of providing scientific means for identifying and comparing materials to be used in the work and the attack on these problems may be said to have been begun in the case of Portland cement.

Hydraulic or Portland cement is a relatively simple compound of fairly uniform appearance. It can, however, vary greatly in quality, and specific quantities of it may or may not be suitable for the purposes contemplated. The use of it has shown certain qualities to be desirable and certain others to be undesirable. Logical reasoning attached importance either fundamentally or incidentally to certain other qualities, and in a fairly short time, therefore, pretty general agreement as to the tests to be made for indicating the suitability of a specific lot of cement for certain purposes, as well as for the identification of the cement itself, was had.

For instance, it was known from experience that to be useful and satisfactory under the usual conditions of work, the cement should neither set up too quickly nor too slowly, and that certain cements which had given good results had a fairly uniform period for reaching the initial set and another for reaching the final set. It could be assumed that a cement which would show a period for these two sets between certain extreme limits would be satisfactory as far as this property was concerned. It therefore became simply a matter of assuming this as one test to be desired and prescribing a uniform method for making the test.

Lecture in Graduate Course in Highway Engineering, Columbia University, February 1916, by W. W. Crosby, C. E., D. Sc., Consulting Engineer, Baltimore, Maryland.

Again, the conclusion could be logically reached from both experience and theory that fineness of the cement was of considerable importance, and a test for fineness or grinding with limitations based on experience was quickly established, as well as a test for specific gravity and for constancy of volume. Further, certain chemical analyses were agreed upon as desirable, and certain practical tests for determining the probable strength of the cement were used.

In this connection, and for further discussion of cement tests, the speaker can do no better than to refer his auditors to the final report of the Committee on Uniform Tests of Cement from the American Society of Civil Engineers, printed in the Transaction of that society, Vol. lxvii., page 427 etc. (or Proceedings, Am. Soc. C. E. for February, 1912, page 103 *et seq.*) where the significance as well as the apparatus and method for making each test is admirably set forth.

The history of cement testing as above outlined has furnished an inspiration for the procedure in the cases of other paving materials, and with some of them, such for instance as the bituminous materials, the progress has been along similar lines and quite extensive, though owing to the more complicated compounds dealt with and the relatively short time that has yet elapsed since the progress was begun, the results in many cases are not as yet as well crystallized nor probably as final, as in the case of cement. However, identification and comparison by trade names or brands has practically disappeared, and they are now being made on a more scientific and dependable basis.

The speaker does not mean to give the impression that the description of some bituminous materials by statements as to their physical and chemical characteristics was not attempted until after the practice had begun as in the case of hydraulic cement. The general use of chemical and physical analyses or tests of bituminous materials for the purpose of identification and comparison has, however, begun and progressed within the last five or six years. The earlier attempts along this line were merely those of trying to describe a specific material by other means than the use of its trade name or brand, and in such description to include certain peculiarities so that anything but the particular material in question could not be considered.

From the progress made in the case of hydraulic cement and bituminous materials, has developed the belief that other materials could equally well be identified and compared through determinations of their chemical and physical qualities to even better advantage in most, if not all, cases, than by means of their names or brands, and we may therefore proceed now to a detailed consideration of the limitations of tests which define the essential properties of certain paving materials under the respective heads in the order mentioned in the title of this lecture.

## I. STONE BLOCK

Specifications for stone blocks for paving purposes have until quite recently almost always provided that blocks should come from certain named quarries, such, for instance, as those at Rockport, Mass., or that they should come from quarries of granite "equal in all respects to the Rockport granite in the opinion of the engineer." In some cases, specifications have provided that the blocks should be "made of granite approved in writing before the bids are opened by the engineer." Usually, and except for such provisions as "no syenite will be allowed to be used, nor any discolored, sappy, or rotten stone, under any circumstances," the further description of the blocks desired or allowed to be furnished was limited to the statements as to their dimensions and surfaces over the joints. Recently, the idea has taken hold that not only could the personal equation present in specifications be reduced, but also it has been thought that the resulting pavement could be better adapted to the peculiar conditions of any case, and a more economical and efficient pavement produced in each case by the proper selection of the blocks for any case on the basis of the

careful consideration of the physical qualities of the material available in any case and of the peculiar value of each of these qualities. On abandoning the name of the quarry, it would seem at first and for some time probably desirable to provide a test or tests which would permit the identification of the material in any case so that its source or origin from a particular quarry or group of quarries known to produce a similar product, could be determined. This is desirable, if for not other reason, for the purpose of permitting a continuation of the acquaintance and information acquired from experience with the material under a trade name and a transference of them over into the experience to be acquired under a different method of identification.

Experience has shown that certain stones which produce satisfactory paving blocks have yet been unsatisfactory for use under certain conditions because of their power to absorb moisture. Frost action on the water-soaked stones has damaged them. Consequently, a test for absorption of water has seemed advisable for inclusion.

Stone block pavements are generally laid to accommodate severe traffic. They have failed or worn out in many cases for various reasons, but it is pretty generally agreed that when the foundations, laying and joining the pavement have all been properly done, the failure or wear may be traced to a peculiar quality of the stone itself. If, for instance, the ruts or hollows have worn in the blocks themselves, it seems probable that the stone was too soft or lacked resistance to abrasion. If, on the other hand, the pavement has become objectionably rough by the individual stones becoming rounded on top, it seems probable that the stone itself lacked resistance to shock at the edges especially, hard though it might have been at the center, and was in fact too brittle to permit evenly, with the joint filling possible, the slight wear comparable with what might be expected from the hardness of the stone itself. The conclusion has therefore been reached that for paving purposes a stone coming between certain limits of softness and hardness or toughness or resistance to wear, is what really is desirable for paving blocks. Further, by establishing some measure for determining the quality referred to, it would seem to be possible to make some selections of material for this purpose, and thus to admit inferior material for use where inferior conditions of traffic might prevail, reserving the superior material for the superior conditions of traffic, thus advancing toward the end of economy.

With a view to arranging any test of the wearing qualities of stone block, the speaker, some eight or ten years ago, attempted to apply to stone block the rattler test used for paving brick. The physical difficulties of the application seemed to prevent its further development. The stone block are too large and heavy for the brick rattler apparatus, and the development of this apparatus to test successfully the large-sized stone paving block seemed an expensive and unnecessary proposition.

The resistance to wear of material for macadam has been successfully tested for use by the Deval or rattler test, and the speaker believed that the material out of which the stone block were to be made could equally well be tested in the same way as the broken stone for the macadam by the Deval rattler. He made a number of tests along these lines and is convinced of the value of the test for indicating the desirability or undesirability of a material with which to cut stone paving blocks.

Any such test as the rattler test is of course an attempt to provide an "accelerated test," so called, or, in other words, to determine in a short time in the laboratory what will happen in a longer time on the street; that is, the results are accelerated. All accelerated tests are supposed to approximate at least the actual conditions of use, though they need not necessarily, and in fact cannot always, duplicate them. The rattler test of the material for stone block pavements criticized as not being a fair accelerated test in that it does not sufficiently closely reproduce the conditions in use. In the first place, the rattler test is a test of relatively small pieces of the material, while the use is of large pieces. It is said that the effects of the traffic on the block in the street, especially when the latter are properly jointed, are mainly an abrasive effect. Nevertheless, there is, even with the best jointed pavements, a considerable pounding effect by the traffic, and when the joints are not the most perfect possible, this pounding effect is comparatively very much larger. As a matter of fact, the rattler test combines the effect of abrasion with the effect of pounding and is probably sufficiently close to the actual effects of traffic in the ordinary case to be acceptable as an accelerated test for material for stone block pavements, as well as for material for macadam. Results of the rattler test of material for stone blocks taken as a whole explain why many stone block pavements have failed. The "turtling" or rounding on top of trap rock blocks is explained by their high coefficient of wear or small per cent. of loss in the rattler itself. The rutting of the soft limestone blocks is shown by the high loss of the material in the rattler, and the satisfactory material in almost every case is found to have come between certain minimum and maximum limits of loss, these minima and maxima having a relation to the traffic undergone. The limits suggested for this test are, for ordinary conditions, a minimum loss of 2.5 per cent., and a maximum of 6 per cent.

Certain other tests thought to bear on this same quality of resistance to wear, such as the toughness test and the hardness test, have been proposed. Their peculiar value is at present somewhat indefinite. The results of the toughness test seem to have a direct relation to the results of the abrasion or rattler test, but as performed at present the toughness test seems less capable of giving the average quality of the material than does the abrasion test. The value of the hardness test, which is usually made according to Mohr's scale, seems slight at present, but further accumulation of information on this particular point seems desirable.

The test for the crushing strength of material composing stone blocks seems to be of value partly for the purpose of assisting in the identity of the material proposed, partly for preventing the substitution of a different material from that called for or desired, and partly for the purpose of assisting to determine the suitability of the material for satisfactorily meeting the conditions likely to exist after its use. It is not quite clear yet how much value a crushing test on the material may show in these directions, but until its lack of value in any one of these three directions shall be demonstrated, it seems wise to make, and to continue making, the crushing test, if not for the first three at least, for the fourth reason first suggested in this lecture, that is, in order to furnish information tending to clarify points still unsettled.

Unquestionably the material of a pavement is to sustain crushing strains, and one can conceive of a material so weak in this respect as to be unsuitable for pavement purposes. It may be said that this weakness of the material would be readily demonstrated by other tests without the necessity particularly for a crushing test, and in many instances, this would probably be the case. On the other hand, it may not be, and it is by no means positive that this is, the case with stone for stone blocks. The speaker believes it is wise, for the present at least, and in the effort to get away from the specification of the material for stone block by name, to include in specifications and to make for the purpose a recording test of the crushing strength of the material proposed to be used. Experience seems to show it to be wise to place a minimum limit in specifications at from 16,000 to 20,000 pounds, as the result of the crushing test.

### II. PAVING BRICK

Specifications for paving brick not so long ago named the brand of the brick; but, thanks to the progressiveness of the National Paving Brick Manufacturers' Association and its able secretary, this practice has departed for good apparently. For some years, the fairly general practice has been to test paving brick mainly with the rattler, though sometimes tests for cross breaking resistance and for absorption have been added. With the improvements in practice as to laying brick securely on a proper bed and as to more perfect joint filling, the breaking of brick in the pavement has so decreased as apparently to render the cross-breaking test superfluous. Further, the rattler test as now standardized seems, in the main, to cover the points attempted to be reached by the cross-breaking test, and to furnish a safe reliance in this respect. The ratler test for brick is claimed by some to render the absorption test unnecessary. The speaker does not think that this point has been conclusively demonstrated, especially as the absorption test should be made on the brick after they have passed

through the rattler, and he would prefer that the absorption test so made should be continued for the present at least, if only to record further data in this connection and to enable the facts to be more conclusively demonstrated. The speaker would also favor the accumulation of information regarding the qualities of paving brick as demonstrated by a compression test on this material. Some failures in brick pavements have undoubtedly occurred through the failure of individual brick to sustain satisfactorily the compressive strains concentrated on them, perhaps through the expansion or contraction of a large area of the pavement. The disintegration of these individual brick has been followed by a general deterioration of the adjacent brick over a considerable area of the pavement. It would therefore seem to the speaker desirable that further information on this line should be accumulated.

The rattler test for paving brick, as standardized by the National Paving Brick Manufacturers' Association and adopted by the American Society for Testing Materials, is so familiar to you all that the speaker will not repeat its detailed description here. This test has received the further endorsement of the Special Committee on Road Materials of the American Society of Civil Engineers, of which the speaker has the honor to be chairman, and your professor of highway engineering is the efficient secretary. This committee, however, has made one addition to the test as otherwise standardized, and believes this addition of great importance. It is the call for the recording of the individual losses of the brick in the charge usually ten in number. This addition is for the purpose of detecting and of preventing any great variation between the individual brick of a lot.

The more uniform the brick are in all respects, of course the more desirable they are, other things being equal. Again, high uniformity may offset certain other deficiencies, such, for instance, as moderately rapid rate of wear. It therefore becomes desirable, not to say imperative, to know the degree of uniformity in a lot of brick as well as the average resistance to wear of the entire lot. Further, for the sake of economy, it is desirable in considering the impossibility in production of making all the brick from a kiln exactly the same as regards resistance to wear, to provide opportunities for the safe use of the less resistant brick as well as to provide a market at a reasonable price for the brick more resistant to wear. If this can be done without sacrifice of uniformity in rate of wear when laid in a pavement, it would seem as though two good ends most "devoutly to be wished" would be served. In other words, if a test for uniformity between the individual brick will serve to compel the sorting of the brick so that different lots fairly uniform throughout each, but with, say, high, medium, and low resistance to wear, will be accumulated, then the more highly resistant brick can be used where traffic conditions are severe and such brick are demanded even at a higher price by reason of economy in the long run; the medium resistant brick can be used under medium traffic conditions at a medium price, and the brick with low resistance to wear can be used under light traffic conditions at a low price, and at the same time greater satisfaction in use can be had. The speaker has been told by the manufacturers that the proposition is not at all impracticable, but is simply a variation, more or less disturbing, from the present practice. On the other hand, when the initial disturbance is over, the speaker has found from experience that the new arrangement is at least as satisfactory for all concerned as the old one was. The principles involved are certainly logical and the elimination of difficulties seems simply to depend on the general acceptance and adoption of the principles. During the transition stage, the allowable limits for the variations in the individual bricks will probably have to be somewhat larger than desirable or even than later can be established without difficulty. Ten points of variation between the individual losses in the charge seems ample at the start, and it would seem quite possible to reduce this variation to a maximum of five or six points as soon as the manufacturers understood what was wanted and adjusted themselves to the new conditions.

It may not be out of place to refer to a suggestion made last year that all laboratory tests for brick be abolished This suggestion came from a locality where apparently a very limited supply of brick was available, and those inspecting the brick had become so well acquainted with the local supply that they had become expert enough, it was claimed, to detect satisfactory brick from unsatisfactory brick by mere visual inspection. Apparently this expertness, if it existed in fact, was based on previous experience with testing. While such a degree of expertness is to be admitted, the speaker suggested that after all it merely demonstrates conclusively the value of the foundation furnished by actual testing. He does not believe it would be claimed that a local expert, even if qualified to pass on the value of the limited supply of brick in one locality, could go elsewhere and finally determine, with any degree of satisfaction, the value of bricks from new sources of supply or for use under different local conditions.

Specifications for paving brick drawn on the basis of a rattler test for the average quality of the brick in the charge now generally provide for a maximum average loss of from twenty to twenty-four according to conditions. The speaker's proposition, if accepted, would permit the specification to admit an average loss of even thirty with a variation of not more than ten points for some cases, an average loss of twenty-five or twenty with a similar limit to variation for other cases, and for the specification to require an average loss of even less than fifteen with a similar limit to variation for other extreme cases.

### III. WOOD BLOCKS

Wood block for paving purposes is a rather complicated article, and as yet only a beginning has been made in getting away from the old form of specification, that is, the description by name and brand. However, the wood block is slowly but surely following along the lines of the other materials. The preservative for the impregnation of the wood is now generally described in terms of its characteristics, although there is still some doubt as to just what analyses of the preservative are necessary and what others, still customarily made, may be superfluous. The speaker does not consider that in this lecture he should attempt to discuss exhaustively specifications for the preservative, so much as he should endeavor to comment on the tests for the wood paving block when prepared ready for use.

Tests on wood block, other than of the preservative expected in the block or used in its preparation, usually include those for determining the character of the wood, the weight of the blocks after treatment per cubic foot, an inspection for soundness, numeration of the rings per radial inch, the quantity of preservative per cubic foot of wood, and the absorption of water by the treated block.

The elusive qualities of wood as a material are known to be extreme, and it has been very difficult to get away from the practice of naming in specifications the kind of wood desired, as well as to determine the kinds of wood which may safely be permitted for use. Further, any one kind of wood may vary considerably according to the conditions under which it is grown and manufactured. Apparently, therefore, many engineers have considered it necessary, for the sake of safety and of insuring a reasonable degree of satisfaction with the results, to specify the kind of wood and certain limitations as to the permissible number of growth rings per radial inch. The limitations in these cases are of course based on experience and therefore purely empirical. Some attempts have been made to obtain a more scientific basis for establishing the quality of the material, but so far, the results have not been widely adopted. It is beginning to be realized that different kinds of woods may be acceptable under similar conditions, and some economy had by permitting the consequent competition. Again, under differing conditions, different kinds of wood may be necessary for the sake of economy, but it is necessary further that with any kind of wood, variable as the material may be, its qualities essential in this particular use of it shall be within certain limts of these qualities, in order that satisfaction may result from its use.

The whole matter is more or less in a transition stage at this time. Some, but not enough, research work has been done. The United States Forest Service has done considerable research work, but most of it has been done with other than paving purposes of the material in mind, and the requirements for these purposes are rather peculiar. For instance, the common use of wood comprises such requirements as resistance to bending and to compression. While paving blocks must resist compression to a certain degree, a still more important quality

perhaps negligible in many other cases of the use of wood, is the resiliency of the wood, or that quality which will enable the wood fibers in a small area to resume their normal position after they shall have been suddenly and more or less violently displaced or deformed by a blow.

The speaker has suggested elsewhere that desirable tests for wood paving block might be along this line, and that were such a test worked out satisfactorily, it might obviate the necessity for describing the wood by name or even for limiting the selection of a particular kind of wood to those specimens having rings of growth per radial inch. If this shall turn out to be the fact, a considerable simplification of the matter would appear to be achieved and a test would be established which would seem to be more directly an accelerated test of the wood block itself.

A test for the quantity of preservative per cubic foot in wood paving blocks is of course simply a check on the material furnished, enabling the referee to decide on the degree of compliance with specifications. The test for absorption of water after treatment is an important one for most American climates. Wood can be preserved indefinitely, by the use of proper material, without seriously affecting its ability to absorb water and consequently to alter its mass between its wet and dry condition. This change of mass of the individual blocks is destructive to the pavement when it exceeds in amount what can be taken up by the elasticity of the blocks themselves in any place where the strains are concentrated. The usual practice in America is to require such impregnation of the wood as will result in an absorption test for the block showing a figure less than the specified maximum, which maximum is established as being a safely permissable limit in the case, and is usually two or three per cent. It has been suggested that some of the difficulties incurred through this provision against absorption might be obviated in another way and is practiced to some extent at least in Europe. That is, where pavements whose blocks may show a higher absorption power than the allowable maximum, may be water-proofed under certain conditions by the application of thin bituminous carpets on their surfaces, and in this way, the possibilities of excessive changes in mass and the consequent destruction of the pavement avoided with economy.

There can be no question but what excessive amounts of preservatives have been used in wood blocks for paving in this country from the view of their wood preserving qualities, and frequently the excess has been more than five times the amount really needed for this purpose. On the other hand, wood blocks whose pores have been insufficiently occupied with water-proofing material have been used disastrously because of the subsequent swelling of the blocks and the destruction of the pavement by the absorption of water.

### IV. CEMENT CONCRETE

General agreement as to the tests to be made on cement concrete has not yet finally been had. The general tendency has been to regard the cement concrete as made up of different ingredients and to make the tests on these ingredients and not on the concrete itself. Even then, final conclusions have not yet been reached as to the tests of the ingredients themselves nor on the methods of making these tests. The main difficulty in the way of the establishment of satisfactory tests for concrete seems to have been the lack of agreement so far that concrete itself is a material to be tested and not simply an aggregation of component materials. Tests of the component materials, such as cement, sand, and broken stone, of course indicate the possibilities of the resulting concrete, but they do not necessarily determine the actualities of the concrete. Differences in proportions of the mix and in methods of making the mix will certainly affect the characteristics of the concrete resulting from the use of different materials, and there seem to be further possibilities of variation in the combination of these ingredients which variations result from some not well understood causes. It therefore seems as though certain tests of the concrete itself are desirable and that as early an agreement as practicable concerning such tests should be reached. For instance a crushing test of the concrete would seem to be more desirable. Such a test would fulfill the four purposes mentioned for testing and in addition to being directly related to the use of the concrete, would seem to be a test of the greatest practical value. Another test probably of considerable value for the fourth purpose mentioned, that is, for the purpose of developing information that would throw light on many points not yet clear, would be a test for density on the hardened concrete, and this test should be made coincidentally with the other tests. A third test seeming to the speaker of value, though perhaps it should be regarded more as an investigation than as a test, would be the attempt to determine the relation between the elastic limits of concrete and its ultimate strength, so that light may be thrown on the other important quality of concrete, that is, its ability to flow or be deformed without disintegration or failure under stress.

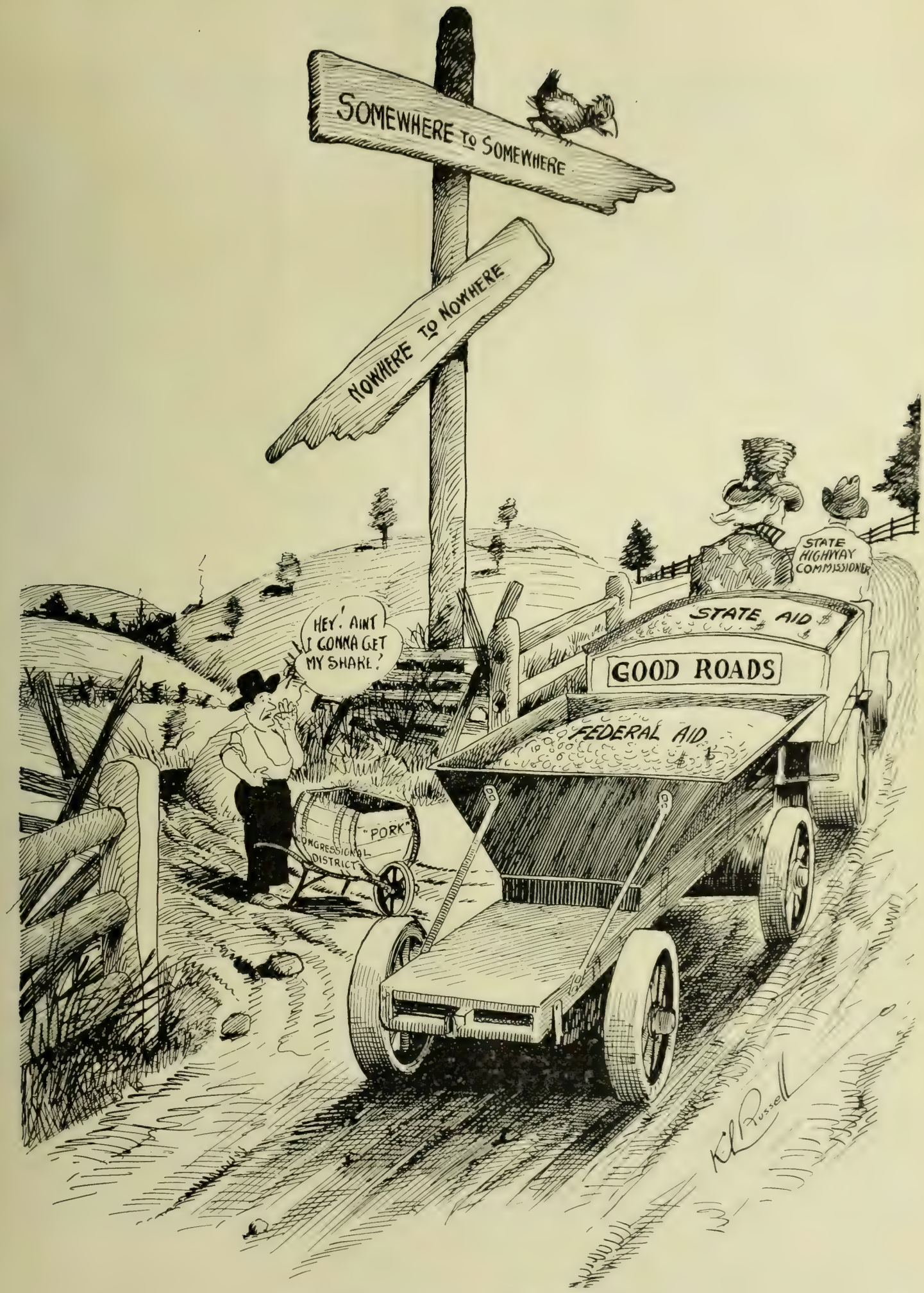
Regarding the present practice of testing ingredients for concrete and of relying on these tests mainly in this connection, there is probably no necessity of going here into the details of the test for cement now satisfactorily standardized. A full description of these tests may be found in the Transactions of the American Society of Civil Engineers, vol. lxxvii, page 427 *et seq.* As regards tests for water entering the concrete, none have apparently been laid down or widely accepted. It is known that what is called dirty water, or water containing grease or acids, should not be used. Apparently clear water may contain acids or reagents which will make its use with cement entirely objectionable, and result in the complete failure of the concrete. Water containing materials in solution or in suspension even, may be objectionable, by reason of its failure to permit the requisite development of the strength in the mortar. Water does not need to be of a purity required for drinking purposes or for hygienic reasons, but it must be free from addition of anything in such a quantity as will weaken the results of its use for mortar. There is need for some research work and for the development of standard tests to control the quality of water for satisfactory use in concrete, before limits of the results of this test can be stated.

As regards the fine aggregate, some definite tests have been proposed, but apparently a lack of understanding and agreement as to what is necessary or desirable in the way of "sand" has so far prevented the general adoption of any conclusive tests for the same. For many years, "sand" for mortar and concrete purposes has been specified to be "clean and sharp." Within recent years, the effort has been made to make its specification more definite and at the same time to extend the limits of definition so as to permit the use of a wide variety of fine aggregates without danger to the results. Still more recently, the theory has been developed that grading of the sizes of the fine aggregate was as desirable in concrete as in the case of sand for sheet asphalt for instance, while another and perhaps older theory that the shape of the "sand" grains was a critical factor in the selection of the "sand," has lost some of its force. In referring to sand, the speaker has in mind the definition proposed by the Special Committee on Road Materials of the American Society of Civil Engineers, which is adapted from the definition adopted by the United States Bureau of Soils. Probably in any discussion on concrete, the use of the word "sand" with its limited meaning should be avoided, and the better term would be "fine aggregate," reserving the term "coarse aggregate" for the broken stone or gravel above the one-fourth inch screen, in accordance with the definitions proposed by the same committee.

Before proceeding further with discussion on tests proposed, or likely to be needed on the concrete as a whole, let us look first at the established tests desirable on application or usually made on the coarse aggregate for concrete.

Concrete for paving purposes must sustain compression and therefore a compressive test of the coarse aggregate seems rational and desirable. It must also sustain attrition or be able to resist satisfactorily the disintegrating influences of shocks. A rattler test for the coarse aggregate therefore seems rational and desirable. In addition, if proportioning of the ingredients for the concrete shall be made logically and not purely arbitrarily and more or less ignorantly, it is necessary to determine the voids in the coarse aggregate to be filled by the mortar and otherwise irreducible. In some cases, it may be necessary to determine the possibilities of the coarse aggregate itself being affected by the action of water. Therefore it will be seen that practically the same tests should be applied to the coarse aggregate for concrete as are applicable to broken stone,

(*Continued on page 52.*)




AVOID THE MAN WITH THE WHEELBARROW

# The Accomplishments of the Philadelphia Bureau of Highways

By William H. Connell, Chief of the Bureau of Highways and Street Cleaning

(*Continued from June issue.*)

### THE OXFORD PIKE SERVICE TEST ROAD

For the purpose of a comparison of the latest practice and theories in concrete road construction, a service test road was constructed on the Oxford Pike, consisting of several sections, differing in the aggregate used. In the respective sections, bituminous wearing surfaces about a quarter of an inch in thickness have also been placed on one-half of the length of each section.

The Oxford Pike Service Test Road begins at the Northeast Boulevard and runs northward to Second Street. a distance of a little over two miles. The road is eighteen feet wide and is subdivided into five principal sections, each 2,250 feet in length, and each of these sections consisting of a different composition of concrete, as follows:

SECTION No. 1.
One part Portland Cement.
Two parts sand.
Three parts gravel.

SECTION No. 2.
One part Portland Cement.
Two parts sand.
Three parts crushed trap rock.

SECTION No. 3.
One part Portland Cement.
One part trap rock grit.
One part sand.
Three parts crushed trap rock.

SECTION No. 4.
One part Portland Cement.
Two parts trap rock grit.
Three parts crushed, hard limestone.

SECTION No. 5.
One part Portland Cement.
Two parts trap rock grit.
Three parts crushed trap rock.

Each of the 2,250-foot sections is again subdivided into two sections of 1,050 feet and 1,200 feet respectively. The 1,050 foot sections have no additional surfacing material, the traffic coming directly upon the concrete, while the 1,200-foot sections are again divided into four parts, each of which is covered with a different type of bituminous wearing surface, the four materials used being refined coal-gas tar (Tarvia), refined water-gas tar (Ugite), asphalt cut back, and Unionite (a mixture of rock asphalt and stone grit). Transverse expansion joints are placed every thirty feet, half of the joints being armored and the other half a strip of prepared bituminous material. Most of the joints are placed at right angles to the road, but a few are placed at an angle of thirty degrees.

Complete cost data has been kept during the construction of the Oxford Pike Road in addition to the detailed data on the materials used in and the methods of construction. This information, which is of more than ordinary interest, will be given in a subsequent article, which will deal particularly with the construction of this well-known, experimental road. The information obtained both from the construction of this road, and from future observation of the behavior of the different sections and materials will be of inestimable value, both to the Bureau of Highways of Philadelphia, and to engineers throughout the entire country, in the future design and construction of roads of this type.

### THE BYBERRY AND BENSALEM SERVICE TEST ROAD.

This roadway was constructed in 1912 and 1913 as a service test roadway, and consists of twenty-six sections of road, each being constructed in accordance with one of the approved standards of country road construction. The details of construction and the first costs of the separate sections were published in a special report that was issued by the Bureau of Highways and Street Cleaning, and a supplemental progress report was issued in 1914. The valuable information that has been thus far obtained will unquestionably be of great benefit to engineers in general in selecting the most desirable type of road construction to be used in any definite location.

### INSPECTION OF MATERIALS.

The system of inspection of materials inaugurated during 1913 and 1914 was continued throughout the past year and its scope broadened to include the systematic plant inspection of creosoted wood blocks and tar and asphalt products for road-surface treatment work, which previously had been inspected by outside inspecting agencies, or only indirectly by testing samples of the completed materials as delivered on the work.

Inspection of bituminous paving plants has been carried on along the same general lines as in the preceding two years, and the work of controlling and regulating the materials and mixtures used in accordance with traffic conditions has been made progressive, as additional information and experience have pointed to possible improvements. As an indication of the scope of this work, a total of six hundred and forty-nine daily average samples of asphalt wearing surface and two hundred and sixty-three daily average samples of bituminous concrete, together with the necessary accompanying samples of refined asphalt, flux, asphaltic cement, sand, etc., were secured by inspectors in connection with their regular duties, and submitted for laboratory tests. The results of this work are reported and filed in permanent form in our offices. During the year 1915, seven hundred and forty-seven samples of vitrified paving block, representing six hundred and seventy-two carloads of material were submitted to the rattler test. Of the six hundred and seventy-two cars, samples from only sixteen, or 2.4 per cent., were rejected because of failure to comply with the specifications of the rattler test, while in 1913 the rejections were 7.2 per cent., and 2.7 per cent. were rejected in 1914, giving further indication of the value of systematic inspection and testing of this material in improving the quality offered by manufacturers for work under our supervision.

Another innovation inaugurated last year was the inspection of creosoted wood paving blocks at the preserving plant by an inspector in the employ of the Bureau. All shipments of wood blocks received during the past year have been inspected at the four plants which furnished this material. Under this system it has been possible to determine at the plant, before beginning the process of treatment, that lumber and oil of satisfactory quality are being used, and to obtain samples and determine the origin of the preservative oil, and the exact method of treatment and the amount of oil being used at the plant. It is believed that this will, together with the observation of the service qualities of the wood block pavements, furnish much valuable information.

The inspection of bituminous surface treatment materials at the plants and refineries was started at the beginning of work last year along lines such as have probably not been attempted by any other city. While it has been customary with many organizations dealing with highway work to inspect or test batches of completed materials at refineries to determine in advance of shipment that they conform satisfactorily to the requirements of the specifications, the work of this Bureau has made an important step in advance of this by specifying that an inspector should be present during the entire process of producing and combining the materials used, thus making it possible to secure samples of the ingredients as well as of the completed mixture, and to determine the method and proportions of combination. These inspectors made such tests at the plant or refinery as were necessary to control the general character and the consistency of the products, while complete tests on both the ingredients and mixtures were made in the municipal laboratories. It is possible by this means for the city to make complete studies of the desirable properties of such materials, and of the variations which should be made in the finished product to suit local conditions, rather than to leave these points almost entirely in the hands of the manufacturer, as has largely been the case in the past.

More rigid inspection of such materials as trap rock for water-bound macadam, gravel and stone chips to be used as covering material for surface treatment work, and sands for concrete and grouting, has been carried on during 1915, together with an effort to educate the inspectors on construction work in regard to the distinguishing features of these materials (in so far as can be determined by superficial observation) by preparing and placing in the district offices standard samples of the different types of these materials. The regular testing of Portland cement and other materials has proceeded as during previous years.

SPECIFICATIONS.

The specifications in use in the Bureau of Highways prior to 1912 were extremely inadequate, containing, as they did, a number of confusing and contradictory clauses, and requiring methods of construction that were not in accordance with the best modern practice. These specifications were entirely remodeled during 1912, and their revision has been steadily progressing from time to time as new improvements in construction are devised, or where it is shown that the phraseology and intent of the specifications may be strengthened.

Last year the Bureau of Highways combined the different specifications for paving and country-road construction into two general specifications, the first embracing all kinds of construction used on city streets, and the second, all classes of construction for suburban and country roads. The issue of these specifications constituted one of the greatest advantages in the work of the Bureau, but, of course, improvements have been discovered since that time and each draft of the specifications is being modified in some particular. The specifications which are in use at the present time, however, are more advanced than those in use in most of the cities in the country, and there is no question but that the method of construction required by them conforms in every case to the best standards of modern practice.

The standardization of the general clauses of the specifications of the Bureaus of Highways, Surveys, and Water by a committee composed of the chiefs of the three bureaus named has marked a pronounced advance in this work, and these general clauses which have been arranged in the chronological order in which the different steps present themselves for the information of the bidder preparatory to and from the submission of the bid to the final payment of the contract, and which are now for the first time, standard for all of the bureaus of the Department of Public Works, are now embodied in the specifications of my bureau for the present year.

## IMPORTANT OPERATIONS OF THE BUREAU OF HIGHWAYS.

NORTHEAST BOULEVARD.

The opening of the Northeast Boulevard from Broad Street to Rhawn Street has been one of the most noteworthy recent accomplishments of the Bureau of Highways, for the opening of this thoroughfare is not only of great importance to the users of the highways, and develops one of the most important through routes in the city, but the improvement will also have a far-reaching effect on the ultimate development of the city, through increase of land values and in opening a section which has been singularly lacking in main arteries of travel.

The boulevard forms a section of the Lincoln Highway, which, entering the city from New York, passes over the Byberry and Bensalem Service Test Road and down into the center of the city via the boulevard and Broad Street. The length of the boulevard from Broad Street to Rhawn Street i 6.58 miles. It has a total width of three hundred feet with a central sixty-foot driveway, two service driveways, each thirty-four feet wide, and the remaining space used for footways, planting, and lawn areas. The total cost of the construction of this boulevard was slightly over $2,810,000, including a number of contracts that have been awarded since 1903.

Of the contracts handled in the past four years, the first contract for work, amounting to a million dollars, awarded to the McNichol Paving and Construction Company, Philadelphia, was executed in 1913 and embraced all the grading, sidewalks, planting, drainage, and the paving of the central driveway from the Tacony Creek Bridge to Rhawn Street. This contract was finished early in 1915. A second contract in the amount of $385,000 was executed in 1914, and called for the reconstruction of the central and side driveways from Broad Street to Second Street, and for paving the side driveways from the Tacony Creek Bridge to Rhawn Street. Work on this contract was started in December, 1915. The work under the contract entirely completed the boulevard northward to Rhawn Street.

In June, 1915, another contract in the amount of three hundred and ten thousand dollars was executed for the extension of the Northeast Boulevard northward from Rhawn Street. Work on this contract was started last summer, and includes the improvement of the boulevard two squares north of Rhawn Street to a point known as Pennypack Circle, at which point the boulevard is divided into three branches. These are known as (1) Bensalem Avenue, which ultimately will form the main route of travel to Bustleton, where it will connect with the Byberry and Bensalem Turnpike, thereby forming the main route to New York City; (2) Poquessing Avenue, which ultimately will lead towards Torresdale, and (3) Holme Avenue, providing a direct route to the Holmesburg section. Under the present contract, but two of these branches, the first and the third, will be improved.

The cross-sections of these branches of the boulevard north of Pennypack Circle differ materially from the cross-section of the boulevard proper. These three branches are each one hundred and fifty feet wide, and consist of two drives, each twenty-six feet in width, between which there is a planting area fifty-eight feet wide on Holm and on Poquessing avenues, and twenty-eight feet wide on Bensalem Avenue. The remaining space at the sides is used for sidewalks and curbs. Work on this contract is now under way, and it will be completed during this year.

THE SOUTH BROAD STREET BOULEVARD.

The South Broad Street Boulevard, which follows the line of South Broad Street from Oregon Avenue to the League Island Navy Yard, was practically finished in 1914, but as it is intimately connected with the other projects leading to the development of South Philadelphia, a description of this important thoroughfare will not be out of place.



**THE NORTHEAST BOULEVARD**

**Center drive paved with bituminous concrete on concrete base with waterbound shoulders Side drives also paved with bituminous concrete on a concrete base.**

From Oregon Avenue to Bigler Street, the boulevard is seventy feet wide. This portion of the boulevard runs through and is a part of the plaza which serves as an entrance to the southern improvements. From Bigler Street to Pattison Avenue, the boulevard is three hundred feet wide, and consists

of a central driveway fifty feet in width, two service driveways each twenty-six feet in width, and footways, planting, and lawn areas occupying the balance of the entire width. From Pattison Avenue to League Island the boulevard is one hundred and forty-three feet wide. On this portion, however, there is but one central driveway, which is fifty feet in width. The balance of the width of the boulevard is occupied by footways and planting areas.

The work done on this boulevard in 1914 completed the improvement from Oregon Avenue to a point sixteen hundred and fifty feet south of Pattison Avenue, at which point the work had to be discontinued on account of the projected erection of a bridge crossing the tracks of the Belt Line Railway. A contract for the construction of this bridge was in progress throughout last year, and the bridge is now about completed. The boulevard will continue over this bridge to the entrance to League Island Navy Yard, the design of the boulevard for this portion being similar to the part that has already been constructed south of Pattison Avenue, although immediately over the Belt Line Railway bridge there will be erected a belvidere which forms an impressive center of the developments in this section. The detailed designs for this part of the construction have already been prepared and will be placed under contract as soon as the bridge work has been completed and money is appropriated for the purpose.

### LEAGUE ISLAND PARK.

The improvement of League Island Park will ultimately develop a tract of some three hundred acres lying at the southern end of the boulevard and immediately north of the United States Navy Yard. The portion of the park lying east of the Boulevard is three thousand feet long and fourteen hundred and fifty feet wide, while the portion lying west of the boulevard is thirty-two hundred feet long and twenty-seven hundred feet wide.

In May, 1914, a contract was executed for the improvement of part of the western portion of the park, as only slightly over five hundred thousand dollars were available for the improvement. The estimated total cost of the complete improvement was in the neighborhood of seven hundred and fifty thousand dollars, so it was only possible to enter into a contract for the heavier part of the work, including grading, paving of the roadways and footways, top-soil, etc. The planting, erection of the buildings and the ornamental features of the park will have to be subsequently performed under another contract when additional funds are appropriated. Work under this contract was carried on throughout all of last year, and at the present time the bulk of the grading, drainage, bridges, and spreading of the top-soil has been completed. The paving of the roadways and the footways is under way at the present time, and will be completed this summer.

The complete designs for both the eastern and the remainder of the western portions have been prepared and the contract for the completion of the entire park can be executed as soon as the funds are appropriated for this purpose. The estimated cost will be in the neighborhood of one million dollars.

### THE SOUTH BROAD STREET PLAZA.

The South Broad Street Plaza, as has already been stated, forms the entrance to the chain of improvements that are being made in the southern portion of Philadelphia. The plaza occupied four complete city blocks. The most striking feature of the design of this plaza is the erection of a monumental granite balustrade which forms a central treatment, and which occupies about one-fourth of the total area of the plaza. The space within this balustrade is to be formally treated with sidewalks, planting, water basins, etc., while the portion without the plaza is to be informally used as a park space.

Owing to the fact that only about one hundred and ten thousand dollars were available last year for the improvement of the plaza, it was only possible to contract for the erection of the balustrade and for the improvement of that portion lying within the balustrade. The contract for this work was awarded about a year ago, and has now been practically completed. It will be necessary to have an additional appropriation of one hundred thousand dollars to complete the plaza improvement.

### THE PARKWAY.

The construction of a parkway from City Hall Square to Fairmount Park was first considered in 1891, and although some five millions of dollars have been expended for the work since that time, it was not until last year that a definite start could be made upon the construction work. This was owing to the fact that the different properties that had been acquired in previous years were scattered along the entire length of the parkway, and there was no single block or square on which all of the properties had been acquired.

In 1914, however, councils at the July meeting, at the request of the Department of Public Works, passed an ordinance authorizing the opening of the unopened portions of the parkway between Nineteenth and Twenty-Second streets, and also between Seventeenth and Eighteenth streets, and contracts were executed in the fall of 1914 to demolish the buildings on these sections. The buildings were finally removed in the spring of 1915, and in April, 1915, a contract was executed for the construction of the Parkway between Nineteenth and Twenty-Second streets. Later in the year another contract was awarded for the construction of that section of the parkway between Seventeenth and Eighteenth streets. The former contract is now completed, but owing to the fact that insufficient funds were appropriated, the latter contract includes only the underground structures and the roadway pavement. The balance of the work will be completed this year, however under another contract.

The parkway west from Logan Square is two hundred feet in width, and has a central driveway eighty feet wide, two service driveways each twenty-eight feet wide, with the remainder of the space taken up with sidewalks and planting areas. The portion of the parkway east of Logan Square is one hundred and forty feet wide, and contains but a single central driveway, which is eighty feet wide. The side spaces on this section are taken up with sidewalks and planting areas. The total cost of the parkway, including property and construction, will be in the neighborhood of ten million dollars.

### REPAVING.

the majority of such locations had been repaved with noiseless pavements in front of all the schools and hospitals where the old-style, granite-block pavement existed. At the end of 1915, the majority of such locations had been repaved with noiseless pavement. A few remaining locations exist in front of schools and hospitals where repaving would be extremely desirable, for which it has not been possible to provide on account of insufficient funds.

During the year 1915, over a million dollars was made available for repaving, and it has therefore been possible to place under contract many important locations where repaving was urgently needed.

Probably the most noteworthy contracts of the year were the repaving of South Street from Second Street to Twenty-Seventh Street, a distance of about two and one-half miles, with wood block on a concrete foundation, excepting between the trolley rails, and at the intersections, where smooth dressed granite block was used; and the repaving of Chestnut Street from Twelfth to Fifteenth streets, with wood block excepting between the rails, where granite block was used. This begins an improvement which has been urged by the Bureau of Highways the past four years. Chestnut Street, excepting for the three blocks that were repaved last year, is paved with sheet asphalt on a broken stone foundation, which type of pavement is utterly unsuited to the character and volume of traffic which this most important street must carry.

The repaving of South Street has been under consideration for several years, and originated through petitions of the property owners which have been received every year, until it was at last possible to get the work under way. The street is very much improved in appearance, which is doubtless an asset to business interests, not only on that street, but also throughout the entire immediate vicinity. The repaving of Chestnut Street has also been a great improvement, and should be continued throughout the entire downtown, business section of the city at the earliest possible date. Several other important streets in downtown Philadelphia were also paved last year, three of these being with sheet asphalt.

The granite block pavement that was laid last year in Sansom Street, between Broad and Fifteenth streets, is of more than ordinary interest. This is the first time in Philadelphia that we have laid a granite block pavement and filled the joints with a mixture of tar and sand, and asphalt and sand. This method is one that has been extensively used in some of the other cities, and it has been found to give a pavement as satisfactory under most conditions as when the granite block are laid with a cement grout filler, and also has the great advantage of preventing the long delay that is necessarily incident to patching the cement grouted pavement on account of the long time required for the latter material to properly set up and harden so that it can withstand traffic.

The contract for the intersection of Germantown Avenue and Mermaid Lane, Germantown, provided for a "Durax" pavement which consists of three-inch cubical pieces of granite laid on a concrete base, with cement grout used as the filler for the joints. This is a pavement that has been used extensively in European cities, and in some few cases in this country, but this is the first time that it has been laid in Philadelphia. The pavement is less expensive than ordinary granite block, and while not as durable, is sufficiently adequate for locations such as this one.

The repaving of Chelton Avenue between Germantown and Wayne avenues, Germantown, where Dunn Wire-Cut Lug brick was used, improves a street that has been in deplorable condition for several years. Many other streets were also repaved, the cost of which aggregated close to three hundred and fifty thousand dollars.

EDITOR'S NOTE.—In the August issue of BETTER ROADS AND STREETS will be found a complete article by Mr. Connell on the construction of the Oxford Pike Service Test Road.

* * *

## The Regulation of Different Classes of Traffic on Public Highways

### By Edwin Duffey

*(Continued from June issue.)*

Section 2. No traction, engine, trailer, steam roller, automobile truck, motor or other power vehicle shall be operated upon or over the State or county highways of this State, nor shall any object be moved over or upon such highways upon wheels, rollers, or otherwise, in excess of a total weight of fourteen tons, including the vehicle, object, or contrivance or load, without first obtaining the permission of the State Commission of Highways as hereinafter provided. No weight in excess of nine tons shall be carried on any one axle of any such vehicle.

Section 3. The tire of each wheel of a traction engine, road engine, hauling engine, trailer, steam roller, automobile truck, motor, or other power vehicle (except traction engines, road engines, and hauling engines) shall be smooth, and the weight of such vehicle, including load, shall not exceed eight hundred pounds upon any inch in width of the tire, wheel, roller, or other object, and any weight in excess of eight hundred pounds upon any inch of tire is prohibited unless permission is obtained from the State Commission of Highways as hereinafter provided.

Section 5. No traction engine, road engine, hauling engine, trailer, steam roller, automobile truck, motor, or other power vehicle, carrying a weight in excess of four tons, including the vehicle, shall be operated upon any State or county highway of this State at a speed greater than fifteen miles an hour; and no such vehicle carrying a weight in excess of six tons, including the vehicle, shall be operated upon any such highway at a speed greater than six miles an hour when such vehicle is equipped with iron or steel tires, nor greater than twelve miles an hour when the vehicle is equipped with tires of hard rubber or other similar substance.

Section 6. The State Commission of Highways of the State of New York, upon proper application in writing, may grant permission for the moving of heavy vehicles, loads, objects, or structures in excess of a total weight of fourteen tons over its State and county highways upon proper application in writing being made therefor, and under such restrictions as said Commission may prescribe.

Section 7. The owner, driver, operator, or mover of any vehicle over any State or county highway shall be responsible for all damage which said highway may sustain as a result of a violation of any of the provisions of the foregoing rules and regulations, and the amount thereof may be recovered in an action of tort by the State Commission of Highways or by any county superintendent of highways of any county, or by any town superintendent of highways of any town in which said violation occurs.

Section 8. These amended regulations to take effect February 24, 1914.

"Section 24 of Chapter 25 of the Consolidated Laws, entitled 'The Highway Law,' provides that any disobedience of any of the foregoing rules and regulations shall be punishable by a fine of not less than ten dollars, and not more than one hundred dollars, to be prosecuted by the town, county, or district superintendent, and paid to the county treasurer to the credit of the fund for the maintenance of such highways in the town where such fine is collected."

These rules and regulations were put forward tentatively with the expectation that increasing experience would necessitate additions thereto. Not only was the endeavor made to prohibit the use of those vehicles that would tend to tear apart or disrupt our roads, but also to limit the total load to be drawn, and then to restrict this total load in its relation to width of tire, thereby precluding the carrying of a load that, even though it might be within the maximum requirement, would still exert a terribly destructive action due to its being borne by narrow tires.

In this connection it would not be amiss to consider the ordinary conditions pertaining to the loads usually met with in traffic. According to data furnished by the Packard Company, they are using the following weights for their trucks; these weights including chassis, body, and load: six-ton, 23,000 pounds; five-ton, 21,000 pounds; four-ton, 17,000 pounds; three-ton, 15,000 pounds; and two-ton, 8,500 pounds.

According to a statement included in that of the Efficiency and Economy Report for 1915, Volume 5, page 107, a census on two roads in Ulster County shows that on stone wagons having wheels four inches wide, the total load ran from seven to nine tons.

Figuring the Packard truck with a total five-ton capacity, which, according to the Packard people, carries 16,000 pounds on the rear wheels, and has twenty-four inch total width of rear tires, the load per lineal inch is only 666 pounds, which comes well within the limits of our present regulations. Figuring the horse-drawn stone wagons, the load per lineal inch would be from 900 to 1,200 pounds. It can be seen from this that the motor trucks are not necessarily the only destructive factors with which we have to contend. It is also noticeable that the auto trucks, assuming the Packard truck a fair example, are keeping well within the specified limits which cannot be said of the horse-drawn traffic.

By further consideration of the actual conditions arising from this question, the following will illustrate: It is well understood that the chief function of the pavement is to so distribute the load that when it reaches the subgrade it is reduced in intensity to the bearing capacity of the material of which the subgrade is composed and will cause no material settlement of it.

Assuming a three-inch pavement and a forty-five degree distribution of the stress, a one-inch tire will distribute its load over an area approximately twelve inches by thirteen inches; but each additional inch in width of tire adds only twelve square inches of earth covered. According to this, a six-inch tire would cover only a space twelve inches by eighteen inches. It is therefore a false idea that the maximum load can be specified as "so many pounds per inch width of tire." Instead of this, a table should be prepared showing the load for each specific commercial width of tire. These values, of course, would be figured for the worst possible conditions, which in this State would probably be equivalent to a fair gravel subgrade and would allow probably one and one-half to two tons per square foot.

In addition to restrictions on width and weight of tire, it is necessary to control the speed at which cars or trucks are operated, particularly as their weight approaches the maximum, since the impact increases very rapidly with the increase of speed.

The five- and six-ton Packard trucks are supposed to be operated at a speed not to exceed ten and one-half miles per hour, the three- and four-ton trucks not to exceed twelve miles per

hour, and the two-ton truck not to exceed fourteen miles per hour. Restriction in speed is generally obtained by means of a governor which, however, does not absolutely prohibit excessive speed. The Packard Company, for instance, seal their governor so that it is impossible to increase the speed beyond their specified limit without breaking the seal. If the seal is broken, the owner loses the guarantee under which the car is sold. It would, therefore, seem to be of advantage or even a necessity to confer with the manufacturers concerning the method of regulating speed and to have them seal the governors according to our regulations.

According to recognized laws the impact is supposed to increase as the square of the speed. If, therefore, we double the speed, the impact is quadrupled. It is very apparent, from this, that the restriction of speed is extremely necessary and cannot be made too rigid nor can the regulations be too strenuously enforced. Almost any time upon the streets of Albany can be seen trucks which are operated at such a speed as to result in a decided vibration, not only to the pavement itself but to the walls and foundations of the buildings along the street. In addition to this, it is a common thing to see a truck with flat rubber tires which have been badly worn or with large chunks taken out of the rubber and each revolution of the wheel giving a terrific impact to the pavement. On many of the trucks they are also using wheels in which are set large blocks of rubber. It is very probable that under the most favorable conditions, these blocks would be very satisfactory, but there is no question that when worn unevenly they cannot but increase materially the damage done to the pavements.

Although an attempt has been made by the foregoing rules to counteract the effects of these bad conditions, yet more strenuous and exacting rules should be made and just as strenuously enforced.

It is to be regretted that no specific mention is made of horse-drawn vehicles in the rules and regulations, but it is the belief of the department that to all intents and purposes, horse-drawn traffic was intended to be included, for, while the damage done is probably not so great as that done by motors, nevertheless, it can do real measureable damage.

For this reason it seems entirely unjust to tax only motor-driven vehicles. Certainly both horse-drawn vehicles and all other classes of traffic which use the highways do more or less damage and, therefore, should pay their proportion of the costs of construction and maintenance.

The weakest portion of the rules and regulations is that part pertaining to penalties and their collection. It is the duty of the town or county superintendent to prosecute violators of these rules and in a few instances where disobedience has been reported to the Highway Department, the town or county officials have pleaded lack of funds for the payment of a competent attorney as their excuse for not prosecuting.

As an example of the variations in weight that our highway must support the following traffic census is appended. Highway No. 364 is an isolated county highway in Albany County of a waterbound macadam type and yet you will note that its motor and horse-drawn traffic are nearly on a par. Highway No. 5321 is a heavly traveled highway in Westchester County of a bituminous macadam type. The results in tons are as follows:

| | Road 364 | Road 5231 |
|---|---|---|
| Motorcycles | 00.0 | 17.0 |
| Motor runabouts | 11.2 | 176.4 |
| Motor touring cars | 63.8 | 1,436.6 |
| Motor trucks | 24.8 | 775.0 |
| Total motors | 99.8 | 2,405.0 |
| One horse, light | 26.6 | 26.25 |
| One horse, heavy | 18.7 | 55.00 |
| Two horse, light | 11.55 | 8.25 |
| Two horse, heavy | 38.4 | 204.0 |
| Total horse-drawn | 95.25 | 293.50 |
| Total both classes | 195.05 | 2,698.50 |

It is our opinion that a possible remedy for most of these ills would be the establishment of a Traffic Bureau, preferably an adjunct of the Highway Department, whose duty it should be to prescribe rules and regulations and direct the enforcement of the same. To this end there should be conferences with automobile builders, studies, and experiments of road surfaces, motor cars, trucks, and horse-drawn vehicles, the effects of varying loads on varying widths of tires, etc. Without delay the tax on the heavy motor truck should be increased.

The licensing of motor buses should be a part of the duties of this bureau and also the proper regulation of weight to be carried, number of trips and speed of bus should be determined.

In connection with motor truck and motor bus traffic, we might quote from the Massachusetts Highway Commissioner's report for 1914, page 53, as follows: "Mr. H. T. Wakeland, Engineer of the County of Middlesex, which is just out of London and has a very large amount of traffic over its roads, has given some very careful figures showing damage caused to roads by motor omnibusses weighing about six tons each when laden. He took certain roads, ten in number, which had heavy traffic and gave the cost of maintenance, not including watering or cleaning, for macadam roads for three years previous to the motor bus traffic and the cost per square yard for the year 1912-13, which were respectively twelve and three-tenths and twenty-five and six-tenths cents, these results being the average of the aforesaid ten roads.

This shows that the average cost of maintenance for three years before the motor bus came in was about twelve cents per square yard per year. Since the motor bus was put on, the cost has increased to over twenty-five cents a square yard a year. The maintenance cost to carry one ton one mile in 1911-12 was one and two-tenths cents. When the motor bus was put on, the maintenance cost was raised to one and eight-tenths cents per ton per mile. Mr. Wakeland's opinion is that this increase was practically all due to the motor bus. The increased cost of the road up-keep has been found to be about four cents per car per mile, or two-thirds of a cent per ton per mile in the case of a motor bus on rubber tires. In many cases the macadam surface has been practically destroyed by motor bus traffic on hard rubber tires. These were macadam roads in good standard condition prior to the inauguration of the motor bus traffic, and more than sufficient to carry the ordinary traffic.....and Mr. Wakeland states, as do the other County Engineers in England, that a license fee of $50 per year for motor trucks is entirely insufficient to pay for the increased cost of mainteance caused by the use of the trucks on the road.

The rules and regulations adopted should be inforceable by law and the prosecution of offenders and the collection of fines, etc., should be a part of the duties of the Attorney General of the State. Even more important should be provisions of the law to make an offender liable to the State in a civil action for all damages caused to the pavements.

As I view it, the whole problem is reduced to the question of regulation and control of power truck traffic and that, too, of the heavier kind. As to the horse-drawn vehicles, the pleasure cars and light trucks, it is known and simple. As to the heavier power truck, it is complex and impending. Every year witnesses the advent of trucks of greater carrying capacity. If today the capacity of bridges was not a restriction upon weight and impact, the problem would be greater and, I fear, would pass control. Inevitable though they be, we must not forget that we have an investment in improved roads to-day of over one hundred million dollars and it must not be lost. We can not block progress, but we can and must control a traffic which threatens rapid destruction of the very instrument which makes the use of the truck possible. Without the roads we could not have the trucks, and they must, therefore, yield to regulation. The firm hand of the State is needed, not to prohibit but to restrain and control—not only to save the roads for others but for the trucks themselves.

Therefore it is incumbent upon us to use all our forethought and all the experience of others, supplemented by iron-clad rules, after we have determined upon a proper procedure to pursue it we are to maintain our splendid system of improved highways and return a proper interest on the money the taxpayers have invested.

* * *

The "type for the place" is a question which should have more consideration by road and street engineers, for to consider this great question carefully and to act consistently will result in the building of more roads and streets, and a larger expenditure for new roads and streets by the tax-paying public.

# Review of New York State Work for 1915

By H. Eltinge Breed, First Deputy, New York Commission of Highways

EDITORIAL NOTE.—The subject matter contained in this article is taken from an address made by Mr. Breed at the recent Good Roads Week at Cornell University, Ithaca, N. Y.

YOUR program has been a comprehensive one. It has been very pleasing to note that the practical aspect of road building has been emphasized here in the selection of topics and discussions, and it is my personal opinion that the men from the outside who have attended the Conference at this University will derive more benefit from the papers that have been read, as well as from the resulting discussions, than was anticipated when Good Roads Week was inaugurated. I am also of the opinion that many benefits will be derived from these meetings by the men of the University who have been in attendance, and that the week's work will be of much value to those who intend to follow highway engineering as a profession.

A few years ago, a highway engineer, to a large majority of the taxpayers, was a joke; good enough, perhaps to add the frills for such communities as had money to waste, but really quite unessential. The statement was common that any one could build a road, and the roads were a sorry witness that any one at least might try. However, good pioneer work was soon done by the bicycle clubs in furthering the cause of good roads. Afterwards, the automobile associations took it up, with a keener realization that if road building were to advance it must, like all other large undertakings, be treated from a scientific standpoint in such a manner as to secure the best results. So different organizations were formed and different highway departments were organized to carry on this work.



H. ELTINGE BREED
First Deputy, New York Commission of Highways

The results speak for themselves. To-day the profession of highway engineer is one of much relative worth and carries with it as much standing as any other branch of the profession. This result is largely due, not only to the work that has been done in the field, but also to the co-operative interest and work of universities like this one, in educating engineers along the lines of highway work.

During the past year our department has had many inquiries from road commissioners and town, village, and city officials, asking for recommendations as to the best types of pavement to use, sometimes giving a general description of the conditions which they were to meet. In all of the replies to these requests, it has been our policy to recommend that they obtain the services of some highway or paving engineer of recognized standing who could personally get in touch with the local conditions and advise them, not only of the best practice to-day, but of the best practice to suit their immediate needs.

We have adopted this policy because so many considerations enter into the selection of the type of pavement to be used that if all the factors involved are not duly weighed, there will be a large waste of public money. Before continuing, I should like to emphasize the fact that to design a highway properly, accurate knowledge of the chemical and physical properties of the materials used, together with information and data in regard to experimental and practical usage is essential. Many failures and a large waste of public money may be charged to the score of experimental chance and lack of adequate knowledge.

In order to be prepared to design a highway properly, it is not necessary to make an experiment of every piece of work, but simply to make observations, for in every State of the Union and in every country of the world, experiments are being carried on in pavement work, with many needless, wasteful duplications. With a clear insight into the materials used and the methods employed, one may gain enough knowledge through observation to devise with good judgment, better types than could otherwise be obtained, and may thereby win the satisfaction of not having wasted public money in needless experimentation. One cannot too forcibly emphasize the fact that when experts differ widely, the truth of the proposition is only discernible after true and exact consideration has been given to every detail, chemical, physical, practical, constructive, and otherwise.

The remainder of this talk will cover the work done by the New York State Commission of Highways in 1915.

Something of the magnitude of the work that is being done in New York State is shown by the following facts:

During the year, 259 contracts, covering 1,102 miles of road were prepared and awarded for construction work (new work). For construction and repair, 184 contracts covering 1,714 miles of road were prepared and awarded, as well as thirty-four broken stone contracts; 19,000 proposals for construction contracts and 12,000 proposals for maintenance contracts were printed and furnished to contractors. Detailed examination has been made of the final estimates for 179 contracts. In the blueprint room, 127,000 blue and white prints were made, using 636,000 square feet of material. In addition to this, in the head office, plans were examined and approved for approximately 1,350 miles of construction work. Part of this was placed under contract during 1915, and included 387 miles of plain, water-bound macadam; 163 miles of water-bound macadam with bituminous surface treatment; 352 miles of bituminous macadam, penetration method; 2.2 miles of bituminous macadam, mixed method; 119 miles of Portland cement concrete pavement; thirty-one miles of brick pavement, and twenty-nine miles of all other types, making a total of 1,073 miles.

During the year 1915, there were completed and officially accepted, 759 miles, and there were completed, but not in time for official acceptance, 324 miles, making a total of 1,083 miles of road completed during the season.

This mileage would reach through Syracuse, Watertown, and Malone, New York, to Montreal, thence to Plattsburg and Albany, to New York City, and thence through Middletown and Binghamton to Ithaca. After one had made this circuit there would still be enough miles of improved road left over to carry one to Rochester.

There are under contract at the present time 739 miles of highway. The large mileage of unfinished work has been due to three general reasons, the first of which is that in the main the season was a bad one, due to long and protracted periods of wet weather; the second, that owing to large demands upon aliens by the countries at war and also to the large demand upon labor by the increased manufacture of war munitions, there was great scarcity of labor throughout the country; and third, that a percentage of our work being let during the summer season, together with the fact that many counties were slow in procuring rights of way, did not make it possible for the contractors to proceed with their contracts in time to complete them during the year.

Up to the present time the maps in use have been inadequate, so with the idea of giving the public better information, we have prepared two maps to be included in our annual report. The first one will include our system as built, with work

under construction on State and county roads. It also will include future State systems as laid out, but will not include the future county system, or "red line" as it is commonly known, which is subject to such frequent changes. The second map is to be the same as the first, except that plus everything in the first map it will show any local connecting roads which would connect up with our system, together with roads that have been improved by towns and counties through which they pass, and are what one might call improved stone roads. This map will have enough places indicated on it so that one can readily orient one's self in a given location, and some of the places of general scenic and historic interest will be indicated by a suitable legend near the title. It is our further intention, just as soon as these two maps are finished, to produce a map on a larger scale that will have practically all of the advantages of the United States Geological sheets and cover all the features enumerated for the two maps above mentioned, in much greater detail, and which will indicate most of the places of scenic and historic interest throughout the State. This map will be prepared in such a manner that additions may be made, and it is the idea of the department, I think, to provide for its sale, as it will be rather more than an ordinary proposition in the matter of expense.

### WORK DONE BY THE LABORATORY

During the past year, 846,317 barrels of cement were tested by the physical laboratory. This was a larger amount than was tested in any previous year. The cement was supplied by twenty-three different plants, and inspectors were maintained at all of these plants, six of which were in New York State, three in New Jersey, thirteen in Pennsylvania, and one in Maryland. In 1914, eleven and one-half per cent. of the cement tested failed, while in 1915, only eight and sixty-three hundredths per cent. failed. These figures, I think, show that the cement industry as a whole realizes what we want, and is trying to give us the best possible material.

Our physical laboratory also tested 1,444 concrete cubes, 973 samples of sand and gravel, and 947 samples of stone.

Our chemical laboratory tested 2,017 samples of oils, asphalts, asphalt blocks, paints, etc. This is an increase of fifteen and one-half per cent. over the largest amount handled in any previous year. These tests for bituminous materials represented 16,000,000 gallons of material, and besides there were tests made representing 777,797 asphalt blocks. There were 269 lots of paving bricks submitted for test, representing twenty-two different brands, or approximately 27,000,000 bricks. From this large amount, thriteen and six-tenths per cent. was rejected by the laboratory test. This does not include the amount rejected and culled in the field.

It may be of interest to note the cost for doing this work of testing. This cost includes the laboratory work, field sampling, and inspection, and our office or bureau charge. These costs for the various materials were as follows:

| MATERIALS | Number of Tests | Cost per Test |
|---|---|---|
| Oils, asphalts, asphalt blocks, paints, etc. | 1,748 | $ 6.83 |
| Portland cement | 867 | 11.47 |
| Brick | 269 | 7.70 |
| Concrete cubes | 1,444 | 0.79 |
| Sand and gravel | 973 | 4.06 |
| Stone | 947 | 2.79 |

### NEW CONSTRUCTION—THE STORM KING ROAD

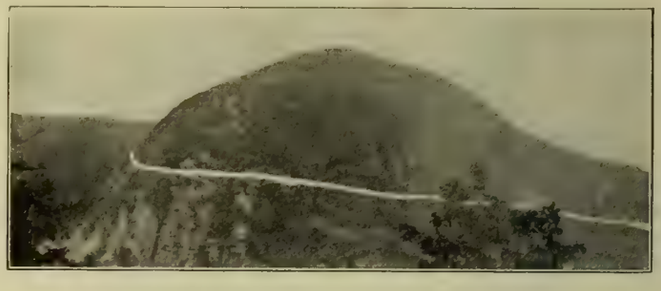
At the beginning of the year 1915, the contract was advertised for a section of the Storm King Road, about 1.27 miles in length, for which the bid was $196,998. Had the department accepted this bid, there would have been left only $188,255 available for the second section, for which the estimated cost was in the neighborhood of $249,000, so that if this contract had been executed there would have been a deficiency of approximately $61,000. In this deficit, too, there was included no item for contingencies, which, because of the nature of the work, we know will be quite large.

When this situation was considered, the bids were rejected, the road re-designed, the alignment changed and certain economics introduced which made it possible to award contracts for the entire road wholly within the amount of money available, and leaving a large sum for contingencies. Toward the latter part of the summer, the contractor started this work and up to the time of closing down for the winter he had about five per cent. of the actual work completed.

I had not intended to say very much about this road, because I presumed that, as the model of it had been shown this past year at Atlanta, at the Panama-Pacific International Exposition, at the Syracuse State Fair, and at Albany during the intervals, almost every one would be familiar with the proposition. However, Dean Haskell wishes me to give a brief description of it.

The original survey of the Storm King Road was made in 1904. The present State Engineer, the Hon. Frank M. Williams, started this survey and made the first preliminary. At that time the road was designed somewhat in the manner of certain sections of the famous Axinstrasser Road in Switzerland. There was about one thousand feet of gallery construction along the side of the mountain, necessitated by a sheer drop of some three hundred feet, and a section of seven hundred feet of tunnel through the nose of the mountain. This was necessitated because we were working at that time on a five per cent. grade limit and the false rock runs up to the elevation of about three hundred and sixty feet. With that five per cent. we could only cut to the elevation of about two hundred feet unless we made some loops, which did not seem to be good practice. In the later design, the grade elevation has been changed to seven per cent., and we have been able to get above the false rock, so the road is entirely in open cut.

This road is going to be one of the important connecting links in State Route No. 3, which runs from the New Jersey



**Storm King Mountain, Orange County, N. Y.**
**Bituminous Macadam surface is being constructed as shown by heavy white line**

line on the west bank of the Hudson River to Albany. There are at present two links in that line which are uncompleted, the Storm King Road and the Rondout Creek Crossing. I do not mean that all the road has been completed, but the other sections of the road that have not been improved by the Commission are in such shape that they can be used by any one traveling through. One other bad section is that known as Hell Hollow, but by the time the tourist season begins this year that section will be open for traffic. The Highway Commission has a contract there a little over two miles in length, and has built the bridge across. When traveling down the Hudson River, you can see one-half of the arch span in place. They were caught by frost last fall and were not able to get the material up the other side.

This Storm King Road is the only outlet along the west bank of the Hudson River for Haverstraw, Highland Falls, and West Point unless tourists and traffic use some of the dangerous roads over the mountain, which roads are steep and would be very expensive to improve. All of the divides are at elevation of somewhere around 1,200 or 1,400 feet, so you may surmise it would be expensive to work up over them.

In 1907, there was a contract prepared for 2.3 miles of this work from the southerly limits of the village of Cornwall to the Reservation line. That was predicated on the possibility that the Government, if the road was built to the Reservation line, would build it within the Reservation. The contract was awarded and the contractor started work. A little later he was

stopped, owing to the fact that some outside interests had bought an old stone quarry that was not of much value, and tried to hold up the State for right-of-way purposes. A taxpayers' action was started and the work was held up a little over eight years.

The survey of this road was rather more work than is indicated by merely traveling along and looking the ground over. It was a pretty dangerous proposition, and two men nearly lost their lives on it. The last one was so badly broken up that he spent some two or three months in the hospital. I have forgotten how many fractures of the legs and ribs he had, but I know that one leg was broken in two places and the other in one or more. I saw him a day or two after the accident, and there was not a part of him that was not bruised or cut in some way or other. He fell about one hundred feet and rolled probably fifty feet.

There were some unusual features developed in making the survey. There was a section about seven hundred feet long that we could not seem to cover. So we had an ordinance sergeant from West Point make some cartridges containing white lead and red lead, and bring up a rifle to mark the points by triangle. But the velocity was so great that it swept the lead off the rock, and only in cases where we could hit straight against it would there be any chance of seeing it. After that we developed a proposition of making rockets at West Point in the ordinance department, in the head of each of which was placed a glass bottle, and after shooting we were able to mark enough points to give us a contour of the rock on the outside. In the latter survey, they rigged up a diamond-shaped target with a rope above, and that was dragged over the rock and raised or lowered as directed by the man in charge of the work, and two instruments were used to locate that. By getting the horizontal and vertical angles, we were able to compute the distance and elevation.

One thing that has made this proposition so difficult is that the rock all the way from the river level up to about an elevation of 500 to 600 feet is pretty much faulted and shattered. That is not a geological term, but the rock has every appearance of being shattered, and at times a great deal of it falls. It was necessary to get through above most of this bad rock, and we expect to have quite a little trouble with it in our construction work. We have made provision for following out the joint planes and getting down everything that is not perfectly solid, so that there may be no danger to the traveling public.

The total amount of excavation on the work is 119,000 cubic yards. There are 25,000 cubic yards of stone and masonry, of which three-fifths are laid in cement. The highest retaining wall section is thirty-eight feet from the base of the wall to the top, not including the parapet. The greatest depth of fill is seventy-five feet and the greatest depth of cutting in rock is 135 feet. The maximum grade is seven per cent. and the minimum radius of curvature is two hundred feet.

Now owing to the fact that the West Shore railroad tracks are just below the work, it was necessary to provide for carrying it on in such a manner as to avoid accidents. We therefore provided for a ten-ton locomotive crane on the track on the siding below at all times, in order to promptly clear away any material that should get down. We also stipulated that the contractor should have installed at all times during the work on the wall sections, an air line which would carry two hundred feet of free air at sixty pounds pressure, in order that he might use it to drill his rock and get it out of the way. In the specifications, we also provided that the contractor should co-operate in blasting with the train despatcher of the West Shore railroad.

This contract was let last July to the John L. Hayes Construction Company, Yonkers, New York, for 4.17 miles at a total cost of $273,736.70. The design in general is cut and fill section, with the rock face coming down at an incline. We step into the rock, build up the retaining wall, go in half way and go up with the slope. The method of working is with an ordinary traveling crane. The contractor makes excavation for footing for the wall and takes out the prism excavation at the same time, using the prism excavation to build the wall. On the start he was able to get along rather rapidly; then he got down to thirty feet per day, and on the last day he worked he was only able to do twelve feet.

RONDOUT CREEK BRIDGE.

This bridge crosses the valley of the Rondout Creek about a mile above the junction of the creek with the Hudson River. The total length of the bridge is about 1,200 feet. The roadway is twenty-two feet wide and a six-foot sidewalk is provided on the north side only. The approach spans are earth filled concrete arches, reinforced with one per cent. of steel and having spandrel walls supported at intervals by counterforts attached to the arch rings.

As the bridge is in full view of the water and rail routes of the Hudson River, and in close proximity to several important centers of population, an effort was made to provide a structure, the dignity of which would be commensurate with the importance of the highway it carries, and of the community whose interests it serves.

The principal factor determining the design of this bridge was the Government requirements for clearance and width of channel. The tracks of the Ulster & Delaware Railroad and the canal and highway contiguous thereto, were also factors in determining the location of the main piers. Owing to the fact that the bed rock in the valley is overlaid with a stratum of river silt averaging sixty feet below mean high water, the expense of sinking piers to this depth precluded the economical use of shorter spans. By the adoption of the two arch spans, sufficient clearance was secured for navigation and the subaqueous construction was reduced to a minimum.

The bridge is to be paved with granite block three inches thick, set in cement mortar. On the steel span the pavement is carried by a concrete slab on steel stringers. On the approach span the pavement is carried on a six-inch concrete base directly on top of the fill. The grade of the roadway is about four per cent., and the bridge span proper will be electrically lighted.

The center pier is founded on piles and the two end piers are on rock. The design of the main steel span was determined by the 200-foot clear channel, with a vertical clearance of 85 feet, as required by the United States Government. The arches are 360 feet span, center to center of pin, with a rise of 110 feet. The floor is designed for an eighteen ton truck on two axles ten feet apart and five feet gauge, with an impact of fifteen per cent. The trusses are designed for a live load of eighty pounds per square foot of roadway and sidewalk. A wind load of thirty pounds per square foot was used to determine the wind stresses.

This is an undertaking which will involve an expenditure somewhere in the neighborhood of $270,000. It is one of the main connecting links on Route No. 3 from New York City to Albany on the west bank of the Hudson River.

NEW POLICIES—MATERIALS

The subject of materials has always been very troublesome, and it has been given extra consideration during the past year with the result that there have been on the one hand, fewer complaints from contractors, fewer cases to be submitted to the Court of Claims, and fewer cancellations; and, on the other hand, much satisfaction on the part of contractors, the traveling public and this department. We have made it a part of every contract that, in so far as possible, the materials to be used in the different items should be definitely stated, so that there might be less of a gamble on the part of the contractor, with the result that I think we obtained much better prices than had been previously obtained. Once specified, the kind and quality of materials were rigidly adhered to throughout the extent of the contract, in order that the State might get value for its expenditure, and that one contractor might gain no unfair advantage over the original competitors in the bidding for the work. The Binghamton case is an example of this method. The contractor went to court because he desired to substitute local gravel for the imported gravel specified. To do so would have resulted in a large saving to him, and a large decrease in the value of the product secured by the State. Fortunately the Department was sustained.

I might say further, in speaking of materials, that it has been the policy of the Engineering Department to make a comprehensive survey of all materials that would enter into any piece of work that we have projected, far enough in advance of the final consideration of the plans to make an economical consideration of the subject of great advantage to the

(*Continued on page 54.*)

# Chemistry, Manufacture, Transportation and Control Testing of Asphaltic Materials

THE asphaltic materials used in the construction of roads and pavements of various types are produced in different ways, depending to a large extent upon the crude materials used, their source, the most economical methods for handling them and the characteristics to be desired of the finished product. As most of my work and experience has been confined to the manufacture and production of asphaltic materials of a compound nature, that is the mixture of two or more bituminous materials, and to the treatment of the various oils by the use of air, I will naturally have to confine myself exclusively to these subjects.

As most of the compounded materials are produced by mixing of a solid bituminous material and an oil I will first take up the mining, transporting, and testing of the solid natural bitumens. The principal solid native bitumen used in the production of asphaltic materials for various purposes, is known as Gilsonite. Practically the only commercial deposits in this country are confined to the States of Utah and Colorado. It is found in fissure veins varying in width from a few inches to five and six feet and of variable depth. The best Gilsonite found in this country has a concoidal fracture and reddish brown streak and is very hard and brittle. On account of its nature Gilsonite is an extremely easy material to mine, the most common form of mining being by the use of the pick and shovel, but some improved methods have been made by the use of steam. It is also comparatively safe mining, although there have been accidents and explosions due to combustion of fine dust. Gilsonite as it comes from the mine is sorted into two different grades, known as Gilsonite Selects, consisting of nothing but the lumps and Gilsonite taken from the center of the vein which runs very uniform, while Gilsonite Seconds consist of the fine Gilsonite and poorer material taken from the outside of the vein which has been oxidized and is of an inferior quality. After being sorted into two grades the Gilsonite is then bagged and is ready for shipment.

In the early days of Gilsonite mining on account of the mines being so far away from the railroads the transportation was very difficult and costly, being in some cases necessary to haul the Gilsonite by wagons sixty or seventy-five miles, one team making only two trips per week. Railroad facilities, however, have been put in the largest mines while those mines more distant from the railroads have been abandoned.

After the Gilsonite is received at the factory it is tested and the following analysis will show the variation in Gilsonites. While the material runs very uniform in each mine the Gilsonite from different mines varies considerable in its characteristics, some of them being practically useless as an ingredient for paving and road materials.

Gilsonite of the very highest quality has also been found in Mexico, and the accompanying analysis will show the difference in charactertistics between that and the product of this country.

Next to Gilsonite the most popular of the solid bitumens used in the compounding of asphaltic materials for road and paving is Grahamite, the principal commercial deposits of this material being found in Oklahoma. Grahamite in appearance very closely resembles Gilsonite. It is, however, very different in its characteristics, Grahamite having a black streak and apparently no softening or melting point, although at a high temperature it fluxes and combines with oil. The results obtained by the use of Grahamite are also different from those obtained by Gilsonite, which I will later describe. This material, however, is used to some extent in the production of paving and road materials by combining directly with oil mixed with certain proportions of Gilsonite.

The mining and production of Grahamite is very similar to that of Gilsonite, with the exception that the veins are much larger and easier to work and are more available to the railroads, making the cost of Grahamite much less than Gilsonite.

Another material very similar to Grahamite but having a different melting point, and in this respect more closely resembling Gilsonite, is what is known as Manjak and is found in the Barabadoes Island and in some part of South America. This material has been little used in this country in the production of road and paving materials, mostly on account of its non-uniformity and because the results obtained have not been sufficient to warrant the increased price over Grahamite. More developments, however, may be expected with this Manjak and for certain bituminous materials outside of the paving and road industry it is a most desirable product. While I am not very familiar with the methods of mining Manjak I understand that they are about the same as those used in mining Gilsonite and Grahamite.

Cuban asphalts have also been used to some extent in the manufacture of paving and road materials, but their use has been limited, owing to their non-uniformity and comparatively high cost, and at the same time it is doubtful if for some years to come these materials will be of much commercial value in the paving and road industry.

As the other principal ingredient used in the production of asphaltic compounds is oil I will now take up in more detail that subject. The oil used in the production of these asphaltic materials is what is known as residuum oil, or the residue of distillation after the gasoline, naphtha, kerosene, and light oils have been removed. This residue varies in characteristics according to the source of the oil or temperature at which it is run or methods used in distillation. There can be a great difference in residuum oil produced from the same crude oil and apparently under the same process, the difference being entirely due to the attention given during the distillation.

In the production of asphaltic materials it is of the utmost importance that the residuum oil be of the highest quality, and we have found from long, and in some instances costly experience, that the only way in which we could distinctly and actually determine the quality of the residuum oil was by the use of the microscope and the slides will readily show you the difference in good and bad residuums. The effect of poorly treated or what is commonly known as cracked oil can be more readily determined when the oil is treated by means of air than when it is merely used as a flux. Crude oils from different sources require special and different attention in distilling, as for instance the residuum from Pennsylvania oils will withstand much higher heat without cracking than will oils from Illinois, the Mid-continent, California, and Mexican fields.

After the oil has been carefully tested to see that it is of the approved quality it is run into storage tanks where it is kept until ready to pump into the asphalt producing stills. It is very important that the oils from different fields be kept separate as they act entirely differently in combining and mixtures of oil unless very carefully and properly handled usually give serious results.

Asphalt for roads and paving purposes composed of residuum oil and one of the solid native bitumens can be made in two different ways, both of which have been used to a large extent. The first way is to pump the residuum oil from the storage tanks into the stills where it is heated by direct or superheated steam to a temperature of 425° F., at which temperature Gilsonite, or any other low melting point solid asphalt is added and thoroughly agitated until all of the asphalt melts into a homogeneous compound with the oil. The percentage of natural asphalt used depends entirely upon the consistency of the asphalt product desired and the nature of the solid bitumen used in the compound. In using Gilsonite by this process the resulting product is in a way similar to what the original residuum would be if it were carefully distilled down until it became of the same consistency, but the addition of the Gilsonite overcomes the loss in weight which would otherwise take place in distillation, and gives the products certain valuable characteristics, but the large per cent. of Gilsonite necessary and the resulting high cost makes this practice practically prohibitive. In using Grahamite, Manjak, and other low quality bitumens it is necessary to heat the oil to a much higher degree than that used in making Gilsonite products. The Grahamite and

Address delivered by H. B. Pullar, President of the Pioneer Asphalt Company, Lawrenceville, Ill., in the Graduate Course in Highway Engineering at Columbia University, December 27, 1915.

Manjak at very high temperatures will mix with the oil and form a homogeneous mixture, but unless carefully watched there is considerable danger either from fire or of overheating and spoiling the product, and materials made from mixing Grahamite or Manjak with oil have the appearance and characteristics of blown oils and in this respect differ from materials made from mixture of Gilsonite and oil.

The second and most generally used method of producing asphaltic compounds with oil and solid native bitumens is to first blow the oil, or in other words treat it for a period of time by the use of air, and which is commonly known as the "blowing process." In the treatment of residuum oil by air the oil is first pumped into the still and gradually brought to a temperature of about 350° F. To bring it to this temperature usually takes from three to five hours, depending upon the size of the still and nature and character of the oil. After it reaches this temperature of 350° F. the air is gradually turned on, through a perforated pipe or pipes in the bottom of the still so as to give an even distribution of the air throughout the entire mass. The volume of air is gradually increased until the valves are wide open and the whole mass is in a violent state of agitation. After the first three or four hours, depending upon the size of the still, it is necessary to maintain heat either by direct fire or superheated steam, but after the process is thoroughly started exothermic reaction starts, the heat is turned off and the process continued for many hours without the further use of direct heat.

The length of treatment by air depends entirely upon the results desired and varies from six to forty hours depending upon the nature of the oil, and as before stated on the resulting product desired. As the batch gradually thickens and changes from an oil into a semisolid, samples are taken from the kettles and tested for both penetration and melting point, and at the desired consistency, which has been predetermined by a formula for some particular material, the air is turned off and the blowing process stopped. Immediately after this is done the Gilsonite or other native bitumen is added in varying percentages, and as soon as this has been homogeneously mixed with the semisolid oil the batch is ready to be withdrawn from the kettles.

One of the most interesting features of treating oil with air is the fact that while the oil is changed from a fluid to a semisolid in a comparatively short time there is practically no loss in weight in the entire batch, (the loss in treating a semisolid asphaltic oil of 18° Be. gravity being less than three per cent.), what small loss in weight there is depends upon the gravity of the oil used and to some extent on the time of treatment, and the accompanying table showing the effect of air upon various oils may prove of some interest.

Another very desirable feature of blown oil is that it can be so uniformly controlled. After the oil has been tested and approved, and the solid native bitumen tested and approved the resulting product of the mixture by the use of treated oil can be kept within five points in penetration and within ten points in melting point. The other characteristics remain just as uniform and it has been found by repeated tests, after a permanent mix or formulas has been made, that it is only necessary to take the penetration and melting point of each batch, and these two tests are used merely as a check on each other, one of them being sufficient for control.

Another particularly distinctive characteristic of bituminous materials produced by the use of treated residuum oil is the fact that such products are less affected or less susceptible to changes in temperature than products made from the same oil but without the air treatment or products made by the distillation process alone. The accompanying table readily shows the difference in these characteristics.

It is not known just what action does take place in the residuum when treated with air, various theories having been promulgated and considerable litigation having taken place to prove and disprove the various theories set forth. The desirability of the air-blown products for use in paving and road building have also been a question of considerable importance but one that we will leave for future consideration.

After the asphalt materials have been prepared and tested and are ready to be drawn off they are allowed to cool until they are from seventy-five degrees Fahrenheit to one hundred degrees Fahrenheit above their melting point at which temperature they are withdrawn from the kettles into barrels or drums or other containers. These drums or barrels are first treated with a preparation to keep the asphalt material from sticking to them and so that they can be readily removed when ready to use the material. After being drawn the material is allowed to cool and then topped off, stored ready for shipment, it being possible to store the highly blown products, such as material to be used for filler, three and four tiers high without serious consequences.

In summing up I would say that in the preparation of asphalt products the one thing of particular importance for the producer to consider at the present time is that of uniformity, as with the increasing tendency of engineers to draw specifications with narrow limits it is necessary to adhere to strict policy of control of both the raw and finished products. Manufacturers and producers are continually solving new problems and finding new and more advantageous methods of production, and as a result much better and much more uniform bituminous materials are being produced today than ever before, and the industry as a whole is being put on a firm and more scientific basis. It has been within the last few years only that the veil of mystery has been withdrawn from the entire asphalt industry opening it up to scientific study and much progress may be expected within the next few years in the chemistry, transportation and control of asphaltic materials.

* * *

## North Carolina

*Robeson County*—

Chain Gang No. 1, made up with twelve mules and twenty-three men, has constructed about one mile of the Wilmington-Charlotte Highway, leading out from Lumberton in a southeasterly direction.

All culverts, except one, have been made of terra cotta pipe. This exception has been constructed of vitrified segmental block. The section through which this mile passes is made up of a very fine, sandy loam for the most part, and clay and sand have been difficult to obtain, except by a long haul. The work of this chain gang will be pushed forward as rapidly as possible, and it is hoped that the Robeson section of the Wilmington-Charlotte Highway may be completed by December first.

The second division of Chain Gang No. 1 is at work on the same highway around Maxton, but is not at work under the State Highway Commission, and definite information is not available just now.

The work of Chain Gang No. 2 is building a fill across Ashe Pole Swamp at the Bullock Ford. This gang has about twenty men and only two mules. The convict labor in this county has been divided into too many sections, and is too poorly equipped for effective work from the point of economy. Gang No. 1 has been greatly improved under the management of the State Highway Commission, but there are still errors to be corrected.

*Caldwell County*—

During the latter part of April and the first of May the road force in Lovelady Township, Caldwell County, graded and top-soiled three and one-half miles of road.

*Beaufort County*—

Work on the roads in Washington Township was begun last week in charge of Mr. R. E. Snowden, engineer. Mr. K. M. Clements has been employed as foreman, and with these two competent men in charge, the work is expected to progress rapidly.

*Cumberland County*—

One year ago, real work was begun on the roads in this county. The old system of road building was done away with, and the roads are now being properly built by the most approved method of sand-clay construction. Special attention is being paid to drainage with berm ditches and outlets for the water. However, the funds are limited and the force small, there being only thirty convicts and twelve mules used under the present competent foreman. By this means about two miles a month can be built, or twenty-four miles a year. There are four hundred and twenty miles of road in the county.

The present system is giving Cumberland County roads, not as fast as the county would like to have them, but they are getting real roads, good twelve months in the year.

*Cabarrus County*—

On account of the very dry weather all spring, the public roads have not required an unusual amount of work to keep

them in fairly good condition. Some work has been done, putting sand and gravel on the soft, red clay or boggy places. The work of scarifying the macadam surface and putting on a layer of crushed stone on the National Highway between Concord and Kannapolis, where it is badly worn, is progressing very nicely. It is understood that the county commissioners have a contract to put a "binder" upon the newly-finished oversurface of this road. This, it is believed, will render it a much smoother and more durable job than the old, water-bound, macadam construction, which has not proven durable under the heavy motor and other travel that uses this thoroughfare. Quite a lot of street grading and paving is under way in the city of Concord, and before many months all of the principal streets and cross-streets will be of the latest cement construction. This certainly is a great improvement in the city's streets. The question is frequently asked us as to how many years, under ordinary conditions, such a paving will last? Would like to have this question fully discussed in the columns of Better Roads and Streets.

Quite an interest is being manifested in the forthcoming Annual Good Roads Convention, to be held at Wrightsville Beach, June 21-23. It is hoped that Cabarrus County will send a liberal delegation. We believe that a great amount of valuable information is given at these meetings, and all who can do so should attend, especially county road officials and county commissioners. Much praise is due Dr. J. H. Pratt, State Geologist, and Mr. W. S. Fallis, State Highway Engineer, and others, for their commendable zeal and untiring efforts to advance the cause of good roads and road maintenance in North Carolina.

It is reported that the county commissioners have awarded the contract for a bitulithic binder for the Kannapolis road. Work will begin on this in a short time and it is expected that the section of the road from Concord to Cook's Crossing will be completed within thirty days. The other section of the road will then be repaired. The binder will cost eight cents a square yard, and it is estimated the highway will measure about fifty thousand square yards.

*Sampson County—*

The road work is still progressing very nicely. They are using the engine and grader for the purpose of maintaining the roads that have been built. The railroad company has stopped the work between Autryville and Wayne on account of the road being built on the right-of-way.

*Iredell County—*

The road work in Iredell County has not been progressing as well as it might, on account of the dry, windy weather, this being very bad on the sand roads. However, the forces, composed of a chain gang, are now working all they can, soiling on Turnersburg Road, and a little later they will look more closely after repairing the broken places in the soil roads.

*Lee County—*

During May, the force in Lee County cleared 5.2 miles of road and graded 4.1 miles. They surfaced 2.1 miles of sand-clay and 2.5 miles of gravel road. There is being built one bridge, which is a seventy-foot, timber bridge, with a twelve-foot roadway, with concrete abutments and piers.

*Caldwell County—*

During the last month, about two and three quarter miles of the Granite and Grace Chapel Road was graded and completed. This was mostly light grade work, and soil was plentiful on two miles of the road. The new concrete bridge over the Granite Falls Manufacturing Company's dam has been in use since the completion of this road. Work has been started on a link of the Hickory-Cedar Valley Road, which connects this road with the Dudley Shoals Road. The remaining two and one-quarter miles of the Hickory-Lenoir Road, in Lovelady Township, has been surveyed, and work will probably begin on same within the next few weeks. This will likely be finished with the mules to be kept for the maintenance and repair of roads already built. The concrete work for the steel beam bridge over Gunpowder Creek is about completed, and ready to receive steel.

*Swain County—*

Ending with the month of May, practically all of the work on the road toward Franklin was completed, with the exception of about three miles on the end toward Macon County, which is mostly rock. There is also about three miles yet to complete on the Almond Road, and one-half mile on the Whittier Road, which consists largely of rock.

There are two main contractors on the grading, Reed and Wells, of Asheville, and Wright-Johnston Contracting Company, of Andrews. Under these contractors are employed six sub-contractors, who are distributed over different sections of the road, thereby covering practically all of the work that is at present under contract.

C. W. Requarth Company, of Charlotte, have the contract for all of the larger bridges. Five of these bridges are now under construction on the Almond Road, consisting of four forty-foot spans on Alarka Creek, and one three-hundred-foot bridge over the Little Tennessee River, at Almond. The steel bridge over the Tuckasegee River at Ela was completed about three weeks ago by the Virginia Bridge Company. It is considered a first-class job.

*Wayne County—*

During May, Camp No. 1 constructed one and one-half miles of sand-clay road, using ten mules, with seventeen men. They excavated eleven hundred cubic yards, and gravel-surfaced one and one-half miles of road.

Camp No. 2 constructed forty-eight hundred feet of road, which was sand-clay, using ten mules and fifteen men. This camp excavated six hundred cubic yards, gravel-surfaced one thousand feet, and cleared forty-two hundred feet. The approximate cost for the work of Camp No. 1 was one thousand dollars, and for Camp No. 2, nine hundred and sixty dollars. In the maintenance work they machined one hundred and eighty miles, and dragged two hundred and fifty miles. This is a very good showing for Wayne County, and during the month of June they are expecting to make a better record than they did for May.

*Avery County—*

Quite a bit of work has been done in Avery County recently. The Banner-Elk-Newland Road will be completed by July first, concrete bridges having been already completed. The Newland-Linville connection with the Yonnahlossee Highway will be completed by the fifteenth, inst. This will complete the belt route of highway from Blowing Rock via Linville, Newland, Banner Elk, Valle Crucis, Shulls Mills, and back to Blowing Rock, which circles Grand Father Mountain, a distance of fifty-seven miles. Our line between Elk Park and the Tennessee State line has been completed. By July first, from Tennessee State line to Plumtree, a distance of sixteen miles, will be complete. Our road from Newland to Linville Falls, via Miller Gap and Crossnore, is now under construction, with about five miles complete. We also have a connection with this line which will go to Pineola and Linville, which will be complete by July first. We expect to send a representative to the Good Roads Meeting at Wrightsville, June 21-23.

*Charlotte-Pinehurst-Raleigh Highway—*

There was a meeting of the Executive Committee of the Charlotte-Pinehurst-Raleigh Highway Association, held in the offices of the Piedmont Commercial Club, Albemarle, North Carolina, at ten o'clock, June first. The following members were present: J. F. Cannon, Cabarrus County; J. A. Groves, Stanley County; Barna Allen, Montgomery County, and J. R. McQueen, Moore County.

The committee organized by electing Mr. Barna Allen, of Troy, chairman, and Mr. J. R. McQueen, of Pinehurst, secretary. State Highway Engineer, Mr. W. S. Fallis, of the State Highway Commission, was present, and gave the committee full information in reference to the kind of road the State would accept, and the prospects for outside help for road building. He also answered, during the meeting, a number of inquiries made by different members of the committee.

Engineer Craig, of the United States Office of Public Roads, recommended that the road be located from Charlotte to Concord, embracing the counties and towns of Mt. Pleasant, Albemarle, Swift Island, Troy, Candor, West End, and thence to Pinehurst. The report of Engineer Craig was approved by the committee.

# The Ohio State Highway Department

By George D. Steele

THE Ohio State Highway Department, although comparatively young as compared with the age and experience of some of the departments in Eastern States, has been particularly active during the past few years, covering the regime of Commissioners James R. Marker and Clinton Cowen, the latter being the present State Highway Commissioner. Ohio, so far as her country roads were concerned, was for many years literally buried in mud, particularly sticky varieties of clay and gumbo being found in abundance throughout every part of the State. This naturally makes the earth road proposition as earth roads go, a serious one, and to secure roads that will stand up under the traffic of a popular farming State, it was necessary to turn to a hard-surfaced road. Therefore, since the activities of the department really started, the program has been almost entirely one of construction. The people of the State responded willingly for the cause, and through a property levy, millions of dollars have been raised during the past few years.

This description of the Ohio Department and its work will be confined to the organization of the department and its methods of working, and the construction work that has been accomplished in the period of the present administration, from April 1, 1915, to December 31, 1915. A subsequent article by the author will be published in BETTER ROADS AND STREETS in August, and will take up the work of the Maintenance and Repair Department, and in which some most interesting facts and figures will be presented.

The department is divided into several main bureaus, the principal of which are the Bureau of Construction, the Bureau of Maintenance and Repair, the Bureau of Bridges, and the Bureau of Tests. As highway improvement naturally starts with construction, the first subject taken up will be the organization and accomplishments of the

### BUREAU OF CONSTRUCTION.

H. M. Sharp, Chief Engineer of the Ohio State Highway Department, is Chief of the Bureau of Construction, with headquarters in the general offices of the Department in the Hartman Building, Columbus. Since assuming office, he has spared no effort to secure in the shortest possible time with the funds available, the greatest mileage of improved roads possible, consistent with proper and up-to-date methods of modern highway construction.

Where a road is to be improved and closely follows the existing location, the first consideration is for the installation of a proper and adequate drainage system that will be a permanent structure, and which, when the road may be resurfaced or reconstructed in years to come, will not have to be torn up and replaced. The question of grades is then given careful consideration, and the old grades on the road are reduced to a minimum, or as near a minimum as may be possible with the funds that are available for the construction of that particular road. If a stone road is being reconstructed, the old metal is preserved and is used in foundation work, thereby effecting a considerable saving in many cases. As the greater part of Ohio is level and rolling, with a network of railroads and interurban electric trolley lines, the question of grade crossings is always, and always will be, a serious one. Particular attention is given to the most dangerous crossings, and wherever possible, they are eliminated by carrying the highway over or under the railroad tracks. Where this is not possible, owing to the location or to the lack of co-operation on the part of the company owning the tracks, curves and dangerous approaches are reconstructed so as to give the longest possible sight line and clear vision of the tracks in both directions for as great a distance as possible to those approaching the crossing. Careful attention is always given to embankments, which are eliminated when possible, and to bridge approaches when an existing road is to be improved. In short, each particular case is given individual study before any attempt is made to make up sketches for the proposed improvement. Within the bounds of reasonable economy, everything is done to make the roads as safe as is possible for those using them, regardless of what type of vehicle they may be traveling in.

The Bureau of Construction supervises and directs its work, after the plans and specifications have been prepared and finally accepted, all of which work is done by the office engineering force of the department, through the following organization:

1. Division Engineers.
2. Resident Engineers.
3. Inspectors.
4. Superintendents for Force Account Work.

The duties of the different divisions of this organization will be taken up and briefly described separately, in the order named above, as this will give a very clear and concise idea of how construction work of any kind is handled by the department.

### THE DIVISION ENGINEERS.

The entire State is divided into eight sections, each of which has a Division Engineer assigned to and in charge of all work in his division. These eight Division Engineers have their headquarters in the general offices of the department at Columbus. During the season of actual construction, these Division Engineers are out on the roads the greater part of the time, as it is arranged that they will visit all jobs under construction at least once a week, assisting the resident engineers, inspectors, and the contractors to get the best results, and to see that all work is being done in strict accordance with the plans and specifications. The Division Engineers then report in writing to the Chief Engineer, the exact conditions as they are found on each road on each visit, and these reports constitute a most valuable record of each road from the time work is started until it is finished. Details must be given as to just how the work is progressing, and after a careful inspection of what has been done, the report must state whether or not everything has been found satisfactory or not. This latter is most important, both to the department and to the contractor, as upon this information depends whether or not the contractor will have deductions made from the monthly estimate of construction done, and in the final payment whether or not the full sum shall be paid him and the road formally taken over by the State.

The Division Engineers have field supervision, for the most part, of all road and bridge construction, maintenance and repair on all roads and bridges controlled by the State within their respective divisions. However, the Bureau of Bridges and the Bureau of Manitenance and Repair also have an engineering force, as they have numerous engineers assigned by the commissioner to their particular bureaus, and who assist the Division Engineers whenever and wherever occasion may demand. The Division Engineers are held responsible for all work within their respective divisions, and report directly to Mr. Sharp, Chief Engineer and Chief of the Bureau of Construction. They are all furnished with automobiles, as it has been found that they can cover a great deal more ground at no greater expense than when they used trains and interurban lines and had to hire rigs to go to the remote sections where work was under way.

### THE RESIDENT ENGINEERS.

With but a few exceptions, there is one Resident Engineer assigned to each of the eighty-eight counties of the State. Their principal duties are as follows:

To make accurate surveys and to prepare the plans and estimates for new roads or for roads that are to be improved. They are also required to do the necessary field work during the construction of any roads in their counties. They assume general supervision of all work that is under construction, assisting the contractors and the inspectors of the department wherever possible, and are in full charge for the department on all work, whether construction or reconstruction. They must keep in close touch with this work, and are required to carry out and see that all instructions of the department and the Division Engineers are carried out by the contractors doing the work. At the close of each calendar month the Resident Engineer is required to make out and send to the office of the department an estimate of the work that has been completed by



M. L. FREEMAN,
Secretary



H. L. HASTINGS
Chief Clerk



CLINTON COWEN
State Highway Commissioner of Ohio



MONTFORD BLAKE
Oftice Engineer, Bureau of Construction



ARCH W. SMITH
Cartographer



JOHN W. GRAHAM, Asst. Deputy
Bureau of Maintenance and Repair



A. S. REA
Engineer of Tests



H. M. SHARP, Chief Engineer
Deputy Bureau of Construction



J. R. CHAMBERLIN
Deputy Bureau of Bridges



A. H. HINKLE
Deputy Bureau of Maintenance and Repair




**DIVISION ENGINEERS**

D. W. Seitz
E. W. Davis
Harwood Lersch

E. C. Blosser
W. G. Smith
C. W. Ozias

T. T. Richards
R. N. Waid

the contractors in his county, together with any notes or comment that would be of interest and value to the general office.

In addition to the duties enumerated above, the Resident Engineer is required to carry out any instructions of a general nature coming from the department, and such as are necessary under the provisions of the Highway Act of the State of Ohio, and any other instructions which may be necessary to facilitate carrying on the work.

THE INSPECTORS.

Inspectors are placed by the State Highway Department on all contract work in the State which comes under the supervision of the Highway Department. They are appointed by the County Highway Superintendent or by the Resident Engineer, who is in charge of the work in the county in which the appointment is made. All such appointments, however, are subject to the final approval of the Chief Engineer of the State Highway Department. The principal duties of the inspectors are as follows:

1. To see that all the requirements of the plans and specifications are fully complied with by the contractor.
2. The inspection of all materials used in construction, both as to the quality and quantity that is delivered on the work, and the quantity which actually goes into the construction of the work for which it is furnished.
3. The selection and forwarding of samples of all materials delivered on the work, unless inspected at the plant, to the Department Laboratories.
4. To keep a daily record of all work done on the contract, and to forward a copy of this report to the office of the department at the end of each week.

The inspector is the department's representative on the ground, and he is expected to remain constantly on the work, and where the work is actually being done. Instruction and every assistance is given him by both the Division and Resident Engineers. Careful inspection is a most important factor, and it is one that is necessary to obtain the best results in road construction. Too much care cannot, therefore, be exercised in the selection and appointment of inspectors, and such appointments should in all cases be segregated from politics.

THE SUPERINTENDENTS.

Where the Highway Department is carrying on some construction by force account because of the forfeiture of a contract by the contractors, or where, in the opinion of the department, this is the best and most economical method to pursue, Superintendents are placed in direct charge of the construction work. These Superintendents are, therefore, in such cases, the immediate, local representatives of the State Highway Department. They are, however, working directly under the charge of a superior, who is generally the Division Engineer, and to whom he is responsible.

THE BUREAU OF BRIDGES.

The Bureau of Bridges has charge of all bridge construction and repair on highways coming under the jurisdiction of the State Highway Department. The Bureau is under the direction of J. R. Chamberlin, Deputy of the Bureau of Bridges. For convenience, the State is divided into two sections by a line running north and south, making an eastern and a western division of bridges. A bridge engineer is in charge of each of these two divisions, while a third engineer specializes in steel bridge design, his work covering both divisions. Each of the division bridge engineers has an assistant, and one draughtsman at the Columbus office attends to the preparation of all plans for the entire State.

The work of the Bureau of Bridges includes both the designing and the preparation of specifications and estimates for the erection of highway structures on main market and intercounty highways by the Highway Department, and also the repair of all such structures, so far as the plans and specifications are concerned. This bureau is at all times at the call of the Bureau of Construction and of the Bureau of Maintenance and Repair.

The Bureau of Bridges also furnishes plans and specifications, estimates and reports, and makes inspections, reporting on the condition of existing bridges, to the county officials in any part of the State, upon request from the latter. The actual supervision of construction or repair work by the Bureau of Bridges is, however, limited, for, as has been stated, its work is performed under the direction of the Bureau of Construction and the Bureau of Maintenance and Repair.

THE BUREAU OF TESTS.

The Bureau of Tests of the State Highway Department is located in Brown Hall, Ohio State University, where there are the best of facilities for testing all kinds of road building materials. Some idea of the amount of work that has been performed by this bureau may be obtained from the following list of tests that were made in the laboratory last year:

| | |
|---|---|
| Paving Brick | 486 Tests |
| Stone and Slag | 282 Tests |
| Portland Cement | 1,537 Tests |
| Gravel and Sand | 657 Tests |
| Bituminous Materials | 215 Tests |
| Miscellaneous Tests | 38 Tests |
| Total Tests Made | 3,215 Tests |

In addition to making the tests of road materials, this bureau does a considerable amount of experimental work, prepares and revises all the material specifications for the department, makes a large number of field inspections to assist in the laboratory tests, investigates and tests the materials used in road construction found in the State, inspects material in many cases in the field, and spends considerable time in going over the roads that have been completed. This latter work is undertaken to be able to watch the behavior of the road surfaces from the year they are completed, and to thus compare the actual performance of materials with the tests that have been made in the laboratory prior to their having been accepted by the department as suitable for road construction, maintenance, and repair.

There is also considerable plant inspection of materials prior to their shipment, these being made principally on brick. On this class of inspection, the State allows not over ten cents per thousand brick, and the manufacturer pays the balance. The Bureau of Tests also makes tests of materials for the various counties, and for manufacturers and producers of road-building materials, which include stone, gravel, sand, cement, paving brick, and all of the various forms of bituminous materials.

WORK OF THE BUREAU OF CONSTRUCTION IN 1915.

Weather conditions throughout Ohio, like many other parts of the country, were unusually bad during the year 1915. They were particularly bad for road construction, and contractors in all parts of the State reported that they had encountered greater difficulties in that year than they had for many years back, and in some cases since they had been in business. There was, therefore, a smaller mileage of roads actually completed than there would have been had the weather conditions been even normal. A larger amount of work was carried over as uncompleted than is usually the case, and there was also a considerable mileage of new construction awarded but not started last year.

The following table shows, by type classification, the mileage of contracts awarded, placed under construction, and completed from November 16, 1914, to December 31, 1915.

| | MILES | MILES |
|---|---|---|
| Concrete— | | |
| Plain | 144.67 | |
| Reinforced | 14.41 | 159.05 |
| Macadam— | | |
| Waterbound | 338.08 | |
| Bituminous | 55.24 | |
| Surface Treated | 54.57 | 447.89 |
| Brick— | | |
| Rolled Foundation | 102.75 | |
| Concrete Foundation | 123.67 | 226.42 |
| Construction of Roadbed and Roadway Only | | 10.11 |
| Total Construction in 1915 | | 843.47 |

The total estimates paid on contracts completed and in progress during the year amounted to $7,649,645.62, which was classified as follows, a portion of the work having been paid on the same roads prior to the beginning of the fiscal year:

| | |
|---|---|
| Total Estimates Paid on Contracts Completed and in Progress | $7,649,645.62 |
| Total Partial Estimates Paid on Same Roads Previous to November 17, 1914, were | 1,709,091.39 |
| Total Paid on Contracts During the Fiscal Year. | $5,940,554.23 |

The estimated cost of roadbed construction for the year was $1,594,293.88. For pavement construction, $7,861,869,91, and for bridges and culverts, $750,034.37. There was also $1,061,158.12 on the National Road, which amount was not divided into roadbed, pavement, and bridges and culverts, and which was not, therefore, included in any of the above figures. This makes a total of $11,267,356.28 as the estimated cost of construction last year. The contract price for the same work was but $10,514,797.67.

The following table will show a classified summary of the work and contracts that were completed during the fiscal year, 1915.

| *Type of Roadway Surface* | *Length in Miles* | *Total Cost* |
|---|---|---|
| Plain Concrete | 68.08 | $ 853,995.46 |
| Reinforced Concrete | 1.24 | 15,490.00 |
| Water-bound Macadam | 157.14 | 1,289,843.26 |
| Bituminous Macadam | 2.53 | 16,179.45 |
| Surface-Treated Macadam | 10.40 | 85,000.29 |
| Brick on Rolled Foundation | 39.57 | 718,360.61 |
| Brick on Concrete Foundation | 77.63 | 1,602,744.45 |
| Construction of Roadbed and Roadway Only | 4.44 | 19,395.53 |
| Bridges and Culverts | | 23,623.00 |
| Totals | 359.03 | $4,624,632.05 |

The following table will show in detail the improvements that were contracted for during the fiscal year of 1915.

| *Type of Roadway Surface* | *Length in Miles* | *Total Cost* |
|---|---|---|
| Plain Concrete | 34.50 | $ 393,565.65 |
| Reinforced Concrete | 13.30 | 159,228.27 |
| Waterbound Concrete | 126.88 | 1,153,806.56 |
| Bituminous Macadam | 39.80 | 447,825.09 |
| Surface-Treated Macadam | 24.20 | 200,049.45 |
| Brick on Rolled Foundation | 21.90 | 354,709.93 |
| Brick on Concrete Foundation | 48.18 | 899,973.95 |
| Construction of Roadbed and Roadway Only | 1.25 | 8,465.00 |
| Bridges and Culverts | | 28,586.95 |
| Total | 310.01 | $3,646,210.85 |

There were 118 new bridges planned and contracted for on inter-county highways under the supervision of the State Highway Department during the year ending December 31, 1914, and 977 new culverts. There were also 83 bridges repaired and 304 culverts repaired in the same period under the direction of the department.

The estimated cost of bridges and culverts was $350,385.63. The pro-rated contract price was $300,431.31. Supplemental contracts amounting to $5,390.78 were also awarded. The estimates allowed up to January 1, 1916, on bridges amounted to $141,936.15.

THE 1915 HIGHWAY FUND.

The total balances remaining from 1914 and the new appropriations made for 1915 amounted to $5,964, 423. 92. The expenditures were $3,595,857.80, leaving a balance of $2,368,-566.12. This was divided as follows:

| | *Balances and Appropriations* | *Expenditures* |
|---|---|---|
| 1914 | | |
| State Aid | $ 301,927.15 | $ 290,982.90 |
| 14 Inter-County Highways | 1,900,385.91 | 1,413,764.63 |
| 14 Main Market Highways | 464,467.91 | 426,129.80 |
| Maintenance and Repair | 572,129.78 | 409,983.90 |
| 1915 | | |
| Inter-County Highway Appro'n | 1,497,710.45 | 352,874.60 |
| Main Market Roads Appropr'n | 534,876.25 | 256,190.46 |
| Total | $5,964,423.92 | $3,595,857.80 |

Leaving an unexpended balance of $2,368,566.12.

The total balances, receipts, appropriations, etc., from all funds from November 16, 1914, to December 31, 1915, were as follows:

| | |
|---|---|
| Total Balances | $3,142,149.50 |
| Total Receipts | 103,720.04 |
| Total Appropriations | 2,914,438.66 |
| Total Gross Receipts | $6,160,308.20 |
| Total Expenditures | $3,695,115.34 |
| Total Lapses | 15,436.05 |
| Total Unexpended Balance, December 31, 1915 | 2,449,756.81 |
| Total Gross Expenditures and Balance | $6,160,308.20 |

* * *

## Report of Committee D-4 on Road Materials American Society for Testing Materials

AT THE annual meeting of the American Society for Testing Materials, held at the New Hotel Traymore, Atlantic City, the last week in June, Committee D-4, which has full charge of all matters relating to road materials, submitted its annual report. There have been many important changes made in this report as compared with the reports of the same committee as presented last year and two years ago, both of which were presented in detail in BETTER ROADS AND STREETS in issues following the close of the annual meeting.

Committee D-4 is recognized as unquestionably the most important technical committee in the United States dealing with the technical side of road materials and tests; and its recommendations, as finally adopted by the society which it represents, are accepted and placed in general use by highway engineers throughout the entire country.

For this reason, the editors of BETTER ROADS AND STREETS, following out the policy adopted two years ago determining to present first hand to its readers at a time when such information is of real value and interest, present in detail the report of the above committee, and in the August issue will publish the proceedings of the American Society for Testing Materials, together with the discussion that followed the presentation of the report of Committee D-4.

The report of Committee D-4 was as follows:

The Joint Conference Committee consisting of members of Committee C-9 and Committee D-4, has given further consideration during the past year to the four proposed provisional tests which were embodied in the 1914 report of the committee, and which were reported on at the annual meeting last year. After careful consideration of the report submitted to the committee this year by the Joint Conference Committee, Committee D-4 recommends that the following four proposed standards, which are appended to this report, be referred to letter ballot of the society for adoption. In the case of proposed Standard No. 2, which has not been previously published as tentative, the committee requests that the necessary nine-tenths vote of those voting at the annual meeting be given to refer this proposed standard to letter ballot this year, as desired.

1. *Proposed Standard Test for the Determination of Apparent Specific Gravity of Homogeneous Coarse Aggregates.* A "Provisional Test for the Determination of the Apparent Specific Gravity of Rock" was presented in the 1914 report. The method outlined therein has been discarded and the proposed method substituted.

2. *Proposed Standard Form of Specifications for Certain Commercial Grades of Broken Stone.* This proposed standard is here presented to the society for the first time, not having previously been published as tentative.

3. *Proposed Standard Method of Making a Mechanical Analysis of Broken Stone or Broken Slag, except for Aggregates used in Cement Concrete.* With but slight modification, this method is the same as the "Provisional Method for Making a Mechanical Analysis of Broken Stone or Broken Slag," presented in the 1914 report.

4. *Proposed Standard Method for Making a Mechanical Analysis of Mixtures of Sand or Other Fine Material with Broken Stone or Broken Slag, except for Aggregates used in Cement Concrete.* With but slight modification, this method is the same as the "Provisional Method for Making a Mechan-

ical Analysis of Mixtures of Sand or Other Fine Material with Broken Stone or Broken Slag," presented in the 1914 report.

The Joint Conference Committee has voted to postpone action on:

1. The methods for the determination of the specific gravity of sand and fine mineral aggregates.

2. The methods for the determination of voids in mineral aggregates.

3. The definitions of aggregate, bank gravel, clay, filler, gravel, grit, loan, sand, screenings, sieve, and silt, until opportunity has been given Committee C-9 to make further investigations pertaining to the methods mentioned and to consider definitions of the terms listed above.

Committee D-4 further recommends that the following five standards, appended to this report, be referred to letter ballot of the society for adoption. Proposed Standards 5 to 7, inclusive, are designed to supersede present standards, as indicated. In the case of Nos. 6, 7, and 9, which have not been previously published as tentative, the committee requests that the necessary nine-tenths vote of those voting at the annual meeting be given to refer these proposed standards to letter ballot this year, as desired.

5. *Proposed Revised Standard Test for Penetration of Bituminous Materials.* This test is designed to supersede the present Standard Test for Penetration of Bitumen (D 5-11). It is based upon the test proposed last year in the report of Committee D-4 by the Sub-Committee on Penetration, which was received and published as a progress report. The test now recommended for adoption was prepared by the Sub-Committee on Penetration during the past year and submitted by them in their report to the committee. This report, containing results of comparative determinations which, it is believed, will prove of value to those interested in the tests, is given in the Appendix to the report of the committee.

6. *Proposed Revised Standard Test for Loss on Heating of Oil and Asphaltic Compounds.* This test is designed to supersede the present standard test of that title (D 6-11).

7. *Proposed Revised Standard Method for Making a Mechanical Analysis of Sand or Other Fine Highway Material, except for Fine Aggregate Used in Cement Concrete.* This method is designed to supersede the present Standard Method for Sizing and Separating the Aggregate in Asphalt Paving Mixtures (D 7-11).

8. *Proposed Standard Method for Distillation of Bituminous Materials Suitable for Road Treatment.* With but slight modification, this method is the same as that tentatively suggested and published in the 1911 report.

9. *Proposed Standard Method for the Determination of Softening Point of Bituminous Materials Other than Tar Products.* This method was outlined in the report presented last year by the Sub-Committee on Softening Point, in which the results of comparative tests of the ring-and-ball and the cube methods were given. The work of the sub-committee during the year warrants the recommendation of the ring-and-ball method as standard.

In addition, Committee D-4 recommends that the following definitions of terms applicable to materials relating to roads and pavements be published as tentative for one year and then referred to letter ballot of the society for adoption as standard, and inserted in the present Standard Definitions of Terms Applicable to Materials Relating to Roads and Pavements (D 8-15).

*Clinker*—Generally a fused or partly fused by-product of the combustion of coal, but also including lava and Portland cement clinker, and partly vitrified slag and brick.

*Mesh*—The square opening of a sieve.

*Slag*—Fused or partly fused compounds of silica in combination with lime or other bases, resulting in secondary products from the reduction of metallic ores.

*Petroleum*—Liquid bitumen occurring as such in nature.

*Topped Petroleum*—Petroleum deprived of its more volatile constituents.

*Rock Asphalt*—Sandstone or limestone naturally impregnated with asphalt.

*Bituminous Emulsion*—a liquid mixture in which minute globules of bitumen are held in suspension in water or a watery solution.

*Viscosity*—The measure of the resistance to flow of a bituminous material, usually stated as the time of flow of a given amount of material through a given orifice.

*Penetration*—The consistency of a bituminous material expressed as the distance that a standard needle vertically penetrates a sample of the material under known conditions of loading, time, and temperature. Where the conditions of test are not specifically mentioned, the load, time, and temperature are understood to be one hundred grams, five seconds, and twenty-five degrees Centigrade (seventy-seven degrees Fahrenheit) respectively, and the units of penetration to indicate hundredths of a centimeter.

This report has been submitted to letter ballot of the committee.

Respectfully submitted on behalf of the committee,

LOGAN WALLER PAGE,
Chairman.
PREVOST HUBBARD,
Secretary.

## PROPOSED STANDARD TEST FOR THE DETERMINATION OF APPARENT SPECIFIC GRAVITY OF COARSE AGGREGATES.

SERIAL DESIGNATION: D....

This test is issued under the fixed designation D....; the final number indicates the year of original issue, or in the case of revision, the year of last revision.

ADOPTED .....

The apparent specific gravity shall be determined in the following manner:

1. A properly selected sample which will pass a 2.54-centimeter (one-inch) circular opening and which will not pass a 1.27-centimeter (one-half-inch) circular opening, and approximately cubical or spherical in shape, shall be dried to constant weight at a temperature between 100 and 112 degrees Centigrade (212 and 230 degrees Fahrenheit).

2. The dried sample shall be suspended in air by a fine wire or thread from a scale or balance and weighed in air to 0.01 gram, which weight shall be recorded as weight *A*.

3. It shall then be immersed, for not less than ten minutes, in clear water having a temperature between 15 and 25 degrees Centigrade (60 and 77 degrees Fahrenheit) until no air bubbles appear on the surface of the sample.

4. After all air bubbles shall have been removed from the surface and after the scales have been balanced, the sample shall be allowed to remain immersed for one minute, and if any change in weight takes place, the sample shall remain in water until the balance remains constant within 0.01 gram for one minute. This weight shall be recorded as weight *B*.

5. After weight *B* has been obtained, the sample shall be removed immediately from the water, the surface water shall be wiped off with a towel or filter paper, and the wet sample shall be promptly weighed in air. This weight shall be recorded as weight *C*.

6. The apparent specific gravity of the sample shall be calculated by dividing the weight of the dry specimen, *A*, by the difference between the weights of the saturated specimen in air, *C*, and in water, *B*, as follows:

$$\text{Apparent Specific Gravity} = \frac{A}{C-B}$$

7. The apparent specific gravity of the material shall be the average of three determinations, made on three different samples, according to the method described above.

## PROPOSED STANDARD FORM OF SPECIFICATIONS FOR CERTAIN COMMERCIAL GRADES OF BROKEN STONE.

SERIAL DESIGNATION: D....

ADOPTED .....

The broken stone shall consist of one product of the operation of a stone-crushing and screening plant without recombining or mixing, and shall conform to the following mechanical analysis using laboratory screens:

Passing screen having smallest holes selected,
From....to....pct.
Passing screen having next to largest holes selected,
From....to....pct.

Passing screen having largest holes selected,
From....to....pct.
Total passing screen having largest holes selected,
100 per cent.

*Example.*—The broken stone shall consist of one product of the operation of a stone-crushing and screening plant without recombining or mixing, and shall conform to the following mechanical analysis using laboratory screens:

Passing ¼-inch screen, 3 to 10 per cent.
Passing 1-inch screen and retained on ¼-inch screen, 80 to 95 per cent.
Passing 1¼-inch screen and retained on 1-inch screen, 2 to 10 per cent.
Total passing 1¼-inch screen, 100 per cent.

Or the analysis may be expressed as follows:

Total passing ¼-inch screen, 3 to 10 per cent.
Total passing 1-inch screen, 90 to 98 per cent.
Total passing 1¼-inch screen, 100 per cent.

## PROPOSED STANDARD METHOD FOR MAKING A MECHANICAL ANALYSIS OF BROKEN STONE OR BROKEN SLAG, EXCEPT FOR AGGREGATES USED IN CEMENT CONCRETE.

SERIAL DESIGNATION: D....

ADOPTED .....

The method shall consist of:

1. Drying, at not over 110 degrees Centigrade (230 degrees Fahrenheit), to a constant weight a sample weighing in pounds six times the diameter in inches of the largest holes required.

2. Passing the sample through such of the following size screens having circular openings as are required or called for by the specifications, the screens to be used in the order named: 8.89 centimeters (3½ inches), 7.62 centimeters (3 inches), 6.35 centimeters (2½ inches), 5.08 centimeters (2 inches), 3.81 centimeters (1½ inches), 3.18 centimeters (1¼ inches), 2.54 centimeters (1 inch), 1.90 centimeters (¾ inch), 1.27 centimeters (½ inch), and 0.64 centimeter (¼ inch).

3. Determining the percentage of weight retained on each screen.

4. Recording the mechanical analysis in the following manner:

Passing 0.64-centimeter (¼-inch) screen, ....per cent.
Passing 1.27-centimeter (½-inch) screen and retained on a 0.64-centimeter (¼-inch) screen, ....per cent.
Passing 1.90-centimeter (¾-inch) screen and retained on a 1.27-centimeter (½-inch) screen, ....per cent.
Passing 2.54-centimeter (1-inch) screen and retained on a 1.90-centimeter (¾-inch) screen, ....per cent.

Total, ....per cent.

## PROPOSED STANDARD METHOD FOR MAKING A MECHANICAL ANALYSIS OF MIXTURES OF SAND OR OTHER FINE MATERIAL WITH BROKEN STONE OR BROKEN SLAG, EXCEPT FOR AGGREGATES USED IN CEMENT CONCRETE.

SERIAL DESIGNATION: D....

ADOPTED .....

The method shall consist of:

1. Drying, at not over 110 degrees Centigrade (230 degrees Fahrenheit), to a constant weight a sample weighing in pounds six times the diameter in inches of the largest holes required.

2. Separating the sample by the use of a screen having circular openings 0.64 centimeters (one-fourth inch) in diameter.

3. Examining the portion retained on the screen in accordance with the proposed Standard Method for Making a Mechanical Analysis of Broken Stone or Broken Slag, except for Aggregates used in Cement Concrete (Serial Designation D..).

4. Examining the portion passing this screen in accordance with the proposed Standard Method for Making a Mechanical Analysis of Sand or Other Fine Highway Material used in Cement Concrete (Serial Designation D..).

5. Recording the mechanical analysis in the following manner:

Passing 200-mesh sieve, ....per cent.
Passing 100-mesh sieve and retained on a 200-mesh sieve, ....per cent.
Passing 80-mesh sieve and retained on a 100-mesh sieve, ....per cent.
Passing 10-mesh sieve and retained on a 20-mesh sieve, ....per cent.
Passing 0.64-centimeter (¼-inch) screen and retained on a 10-mesh sieve, ....per cent.
Passing 1.27-centimeter (½-inch) screen and retained on a 0.64-centimeter (¼-inch) screen, ....per cent.
Passing 1.90-centimeter (¾-inch) screen and retained on a 1.27-centimeter (½-inch) screen, ....per cent.
Total, 100.00 per cent.

## PROPOSED REVISED STANDARD TEST FOR PENETRATION OF BITUMINOUS MATERIALS.

SERIAL DESIGNATION: D5....

ADOPTED, 1911; REVISED.....

*Definition.*

1. Penetration is defined as the consistency of a bituminous material, expressed as the distance that a standard needle vertically penetrates a sample of the material under known conditions of loading, time, and temperature. Where the conditions of test are not specifically mentioned, the load, time, and temperature are understood to be one hundred grams, five seconds, and twenty-five degrees Centigrade (seventy-seven degrees Fahrenheit) respectively, and the units of penetration to indicate hundredths of a centimeter.

*Apparatus.*

2. The container for holding the material to be tested shall be a flat-bottom, cylindrical dish, fifty-five millimeters ($2\,^{3}/_{16}$ inches) in diameter and thirty-five millimeters (1⅜ inches) deep. (This requirement is filled by the American Can Company's Gill style ointment box, deep patters of three ounces capacity).

3. The needle for this test shall be of cylindrical steel rod 50.8 millimeters (two inches) long and having a diameter of 1.016 millimeters (0.04 inch) and turned on one end to a sharp point having a taper of 6.35 millimeters (one-fourth inch).

4. The water bath shall be maintained at a temperature not varying more than one-tenth degree Centigrade from twenty-five degrees Centigrade (seventy-seven degrees Fahrenheit). The volume of water shall not be less than ten liters and the sample shall be immersed to a depth of not less than ten centimeters (four inches) and shall be supported on a perforated shelf not less than five centimeters (two inches) from the bottom of the bath.

5. Any apparatus which will allow the needle to penetrate without appreciable friction, and which is accurately calibrated to yield results in accordance with the definition of penetration, will be acceptable.

6. The transfer dish for container shall be a small dish or tray of such capacity as will insure complete immersion of the container during the test. It shall be provided with some means which will insure a firm bearing and prevent rocking of the container.

*Preparation of the Sample.*

7. The sample shall be completely melted at the lowest possible temperature and stirred thoroughly until it is homogeneous and free from air bubbles. It shall then be poured into the sample container to a depth of not less than fifteen millimeters (five-eighths inch). The sample shall be protected from dust and allowed to cool in an atmosphere not lower than eighteen degrees Centigrade (sixty-five degrees Fahrenheit) for one hour. It shall then be placed in the water bath along with the transfer dish and allowed to remain one hour.

*Testing.*

8. (a) In making the test, the sample shall be placed in the transfer dish filled with water from the water bath of sufficient depth to completely cover the container. The transfer dish containing the sample shall then be placed upon the stand of the penetration machine. The needle, loaded with the specified weight, shall be adjusted to make contact with the surface of the sample. This may be accomplished by making contact

of the actual needle point with its image reflected by the surface of the sample from a properly placed source of light. Either the reading of the dial shall then be noted or the needle brought to zero. The needle is then released for the specified period of time, after which the penetration machine is adjusted to measure the distance penetrated.

At least three tests shall be made at points on the surface of the sample not less than one centimeter (three-eights inch) from the side of the container and not less than one centimeter (three-eights inch) apart. After each test the sample and transfer dish shall be returned to the water bath and the needle shall be carefully wiped toward its point with a clean, dry cloth to remove all adhering bitumen. The reported penetration shall be the average of at least three tests whose values shall not differ more than four points between maximum and minimum.

(b) When desirable to vary the temperature, time, and weight, and in order to provide for a uniform method of reporting results when variations are made, the samples shall be melted and cooled in air as above directed. They shall then be immersed in water or brine, as the case may require, for one hour at the temperature desired. The following combinations are suggested:

At 0.0 degrees Centigrade (thirty-two degrees Fahrenheit), 200 grams weight, sixty seconds.

At 46.1 degrees Centigrade (115 degrees Fahrenheit), fifty grams weight, five seconds.

### PROPOSED REVISED STANDARD TEST FOR LOSS ON HEATING OF OIL AND ASPHALTIC COMPOUNDS.

SERIAL DESIGNATION: D*6*....

ADOPTED, *1911*; REVISED.....

The amount lost by oils and asphaltic compounds when they are heated in an oven at a temperature of 163 degrees Centigrade (325 degrees Fahrenheit), plus or minus one degree Centigrade, shall be determined by heating fifty grams of the water-free substance contained in a flat-bottom dish, the inside dimensions of which are approximately fifty-five millimeters ($2\,^3/_{16}$ inches) in diameter by thirty-five millimeters ($1\frac{3}{8}$ inches) deep (three-ounce Gill style ointment box, deep patters), for five hours.

The oven in which the substance is to be heated shall be brought to the prescribed temperature before the sample is introduced, and the temperature of the sample under test shall be regarded as that of a similar quantity of the same material immediately adjoining it in the oven, in which the bulb of a standardized thermometer is immersed.

The oven may be of either circular or rectangular form, and the source of heat either gas or electricity.

The samples under test shall rest in the same relative position in a single row upon a perforated circular shelf 24.8 centimeters ($9\frac{3}{4}$ inches) in diameter, suspended by a vertical shaft midway in the oven, which is revolved by mechanical means at the rate of from five to six revolutions per minute.

NOTE—If additional periods of heating are desired, it is recommended that they be made in successive increments of five hours each.

If the residue after heating is to be tested for penetration, the sample should be thoroughly mixed by stirring until it is cool, and thereafter manipulated in accordance with the directions of the Standard Test for Penetration of Bituminous Materials (Serial Designation: D....).

(*To be concluded in August.*)

* * *

## Apply Business Methods to Road Improvement

It is somewhat with pleasure and somewhat with regret that I come before you to-day to talk upon the subject of "Applying Business Methods to Road Improvement." It ought to be a pleasure to any man to talk to a body of men upon so great a subject as that of "Applying Business Methods to Road Improvement," yet there are some things that I regret very much, which I believe will hinder, rather than help in getting business methods applied to the improvement of our highways.

When you stop to think that there are many different and distinct organizations in this State that are holding meetings and short courses in highway engineering, each working separately, and in many cases, with no thought of the welfare of the traveling public as a whole at heart, but rather working for the interests of what some few individuals might gain personally or politically. I cannot see why these different organizations cannot unite into one great organization, whereby each of the different factions can be represented and hold meetings often enough that they may be able to work out a system whereby the tax-payers and the traveling public will receive the greatest amount of benefits, and have good roads the greater part of the year, instead of each organization working separately for the pecuniary benefits that some few individuals may derive from the taxes paid by the people of this State, regardless of whether we have good roads or not.

True, I believe we cannot have hard roads built all over this State, yet, as I see it, if these organizations would merge into one great organization, and each particular person engage in this work—work with the spirit of co-operation and apply business methods, I dare say we could have good roads and in the course of a few years they would be measured by miles as compared with inches of to-day.

The problem of road building is old as history, but the problem of transportation of to-day is an entirely different problem as compared to that of just a few years ago. I venture to say that there is not a man here to-day, who, twenty years ago would not have known every man passing by his dooryard, where he was going, whom he was going to see, and when he was coming back. I would like to ask you gentlemen here to-day, what per cent. of the people passing your door in a single day that you know, and it is not an uncommon sight to see an auto with a license from New York or California.

The purpose of a road and its place in a community has absolutely changed in the last decade. With the advent of the auto, the road has ceased to be a means alone for getting people to town and products to market, but has become a thoroughfare for the transportation of supplies and for pleasure trips, from town to town, county to county, State to State, and coast to coast.

Our roads, or rather our system of road building, has not kept pace with the change. This is particularly so in Illinois. If our farming and living methods were as far behind the trend of the day as our road-building methods, we certainly would be living in the conditions of our forefathers, which was all right in their days, but certainly does not fit into the modern scheme of doing things. In the pioneer days, people were forced by certain conditions to live by the community plan. They had log rollings, husking bees, barn raisings, etc., and should a man live on a back section, it made it necessary for the community to combine and build him a way to get out, it was not a road, as we know them to-day, but answered his needs.

In this method of road building, each man did what he considered his share for his own good. From this method of procedure came the old path-master system, where it became necessary to appoint some one to see that each individual did his share toward the roads we had to travel. From this came the poll-tax idea, whereby laws were enacted to compel each able-bodied man to work or contribute some cash toward the construction and repair of the roads that were used in common, These roads were perhaps sufficient for the traffic, at least they were as good as could be made under the circumstances; but the suprising thing to me, that although our modern conditions are radically different from those existing in pioneer times, our method of road building has virtually stood still, although the amount of money expended has been multiplied many times over.

In every other industry or profession other than that of road building, the old regime has given away to the specialist. For a comparison, a few years ago the barber was somewhat of a physician; he administered "yarbs" and physics, and if he didn't know what else to do, he bled people, hence we have the striped pole. But no man with modern ideas would be expected to go to the barber to-day to administer to his family. We have adopted the physician, the surgeon, and the pharmacist, each educated and equiped to fill his place in the community, and we have relegated the barber to a more scientific method of conducting his business.

This is an age of specialization, and what appeals to me as one of the most peculiar conditions I meet, is, the amount of

Address by R. W. Osborn, President of the Illinois Association of County Superintendents of Highways, Annual Meeting, Peoria, Illinois, May 31, 1916.

credence put in opinions of road building given by men, who, as compared to a competent road-builder, would size up just about as well as the average barber, as a physician, would with Mayo Brothers.

As long as we are content to work under the old regime of twenty years ago, we will have what we deserve, just what we have now. If you do not believe the method in which the road and bridge tax in your home county is spent compares very favorably with that in vogue twenty years ago, I ask you—I even dare you to go back to your township's books, if you have any, and find out.

I have made a considerable investigation regarding conditions all over the State, and a very thorough investigation of my home county—Livingston—which conditions I set forth in a report to the Board of Supervisors, and from my investigations I am prepared to say conditions are no different there than in any other county in Illinois. Personally, I question whether or not Livingston County is as bad as the average.

I suggest that there is but one answer to this problem, and that is the "Applying of Some Business Methods to Road Improvement." First, that there be some uniform system of accounting adopted whereby the taxes paid by the people may be accounted for. Second, the elimination of the township board as it now exists—as a road-building factor.

We, in Livingston County, have evolved and adopted such a system of accounting, which has been taken up in several counties in the State. Livingston County spent one hundred and sixty thousand dollars for road maintenance through the township boards last year. Knowing we were not getting value received from the tax levy, I made an investigation in several townships, and although I was prepared for some startling conditions, I must confess I was somewhat surprised, as to the conditions I found in regard to the manner of accounting for the road and bridge tax. Quoting from my report of the February meeting of the Board of Supervisors, a copy of which I would be glad to mail any one of you, I found these conditions: No reports of the highway commissioners published in 1914, and that the amount spent miscellaneously was thirty-seven per cent. of their total amount of funds, which means it was wholly unaccounted for. Is this so of your home township? You don't know, and I'll dare you to find out.

I found this condition, that there were practically no records kept over periods ranging from two to twenty years, and although the law plainly stipulates that there shall be a shed for machinery, and not allow the same to go to waste, in some of these few townships where they did have a shed for machinery, they were used by private individuals and the township machinery stood out the greater part of the year. Has your township a shed for machinery? If so, what's in it? You don't know, and I'll dare you to find out.

It is almost a universal practice to piecemeal out their orders for supplies into lots of less than two hundred dollars, the only apparent reason for the refusal of the Township Board to co-operate with the County Superintendent of Highways, as I see it, is to try to stimulate in the minds of the tax-payers the inadvisability of such a county office. Is your home Township Board piecemealing out their orders for supplies under the two-hundred-dollar limit, at the expense of the taxpayers? Or, are they co-operating with the County Superintendent of Highways, trying to get the most for their money? You don't know, and I'll dare you to find out.

Perhaps the most outlandish conditions I have found in my investigation was the manner of purchasing machinery and supplies; these items alone run into many thousands of dollars.

Knowing somewhat the conditions, I called a meeting of the commissioners, and asked several of the road machinery concerns to submit prices, which they did. Immediately after the meeting, many township boards bought their equipment at from twenty to fifty per cent. above the prices submitted at this meeting. This was done in many instances, of course, after a junketing trip, promoted and engineered by the affable salesman, to Chicago, Peoria, or some other place, where perhaps these public-paid servants could see the "bright lights," and have the necessary trimmings, presumably at the salesman's expense, but the very fact that these purchases were made at twenty to fifty per cent. above prices already in the hands of these same board men—it leaves us at the same place: the salesman "got his," and the commissioners "got theirs," in a way, and the taxpayer and the traveling public were the "goats." Did your home Township Board take a junketing trip at the taxpayers' expense? You don't know, and I'll dare you to find out.

Was any member of the Township Board at the automobile show in Chicago, at the supply man's expense? There were several of them there. Was any member of your Township Board at the Cement Show at Chicago, as a guest of some machinery concern? There were several hundred of them there. How many trips has your home Township Board made to—well, say Peoria, in the last year, at the other fellow's expense? You don't know, and I'll dare you to find out. If they did make these trips, what did they buy? And how much more did they pay for it than you could have purchased it through the County Superintendent of Highways of your own county? In other words, what did these junketing trips cost the taxpayers of your home township? You don't know, and I'll dare you to find out.

I would like to take you back over a period of just a few years. About eight years ago there was a State Highway Commission appointed as an advisory commission. A number of progressive Highway Commissioners of this State took advantage of the conditions and advised with the Highway Commission, the result was that there are a number of permanent structures built throughout the State. Then in 1913, the Tice Road Law came into effect. This law also provided for a County Superintendent of Highways, and gave him certain statutory duties.

This law was not created because the people demanded better roads, but because there were too many *tin* bridges, which had been built in the past, that required two coats of paint before they were able to make a shadow, and if the passing of Tice Road Law in Illinois, which created a State Highway Commission and the County Superintendent of Highways was to die a natural death to-morrow, it has proved to the taxpayers of this State the right it had for existence, for it has beaten the tin bridge, and the officials in charge have erected, not hundreds, but thousands, of permanent monuments in the way of permanent bridges to their memory.

Good roads is the live, burning question of the hour, and will be until we get them, but we will not get them without a hearty co-operaion of all our efforts and forces. However, progress will be slow. Up to this date we have not had the co-operation necessary to achieve the results, but public opinion is ripening, and day by day the people are getting closer together in their belief along this line, and the outlook is good. What we need is the combined forces and resources of the National Government, the State Government, and the county government. When this has been done we will meet the approval of the individual, then no power on earth can stop the advance. When thoroughly organized, these forces will be irresistible.

With my whole heart, I believe in law enforcement—not capriciously, nor with the harshness of a tyrant, but an even, consistent, clean, manly, fearless, and impartial enforcement. The law is not a whimsical tyrant actuated by revenge—to-day one thing and to-morrow another—but it is a kindly, nursing father, and can be administered so as to win the respect of every right-thinking man.

If there are any of you here to-day that do not believe in applying business methods to road improvement, examine yourselves and especially the complicated movements of your hearts, modify that which needs changing, and rectify each irregular motion, and you will feel better and the world will be better by having you living in it.

* * *

Yale, Iowa, is a town that had 273 population at the time of the 1910 census. It is a marketing and shipping town for an agricultural region. There is a bank there run by L. M. Swindler, who has offered to give ten dollars a mile to help surface with gravel the roads leading to the town. He explained his offer this way: "I do this for the very simple reason that the better the roads leading to our town, the more business will come to us. The more business that comes to our town, the more business I stand a chance to get. I know of no better investment a business man can make than to assist in creating good roads leading to this town."

# Essential Details of the Construction and Maintenance of Brick Pavements

### HISTORY OF PAVING BRICK

ACCORDING to Prof. H. A. Wheeler, of the Missouri Geological Survey, brick for street paving has been in use for more than a century in Holland, where the absence of natural paving material developed a very durable quality of paving brick by mixing the fine river silt or mud with sand. The village of Moor, on the river Yssel, is especially famous for the excellence of its brick and the magnitude of its paving brick industry. To a much less extent and for a shorter period, they have been used in northern England, especially in Staffordshire and Leeds, under the name of "blue brick" and "terro-metallic ware," where the application is restricted more to stables, chemical works, and similar places where a non-absorbent brick is desired. When the clay is not readily fusible, slag, mill cinders or chalk dust is added in English practice to secure the fluxing or vitrification that is so essential in this class of brick. Paving brick was first used in the United States at Charlestown, W. Va., in 1870, a town of twelve thousand people, where a small section was laid as an experiment. This proving satisfactory, a block of one of their principal streets was paved in 1873, in grading for which it was necessary to take up the small section laid in 1870. This pavement, it is reported, is still in use, although laid on a poor foundation of boards; and while the street has been repeatedly torn up for laying pipe, etc., it is still in fair condition after forty-two years' service. This brick was a side-cut, repressed, hard-burning, building brick of high density. Bloomington, Illinois, a town of twenty-six thousand, laid an inferior paving brick in 1875, on one of the principal streets that lasted twenty years before it was replaced by a high-grade shale pavement. St. Louis, Mo., put down three trial lots of brick in 1880, one of which was the result of experiments dating back to 1873, the Sattler brick. They all proved failures from being either too soft or too brittle, although they were laid on a poor foundation. Another lot of Sattler brick was tried in 1881 that was successful, but the maker was unable to furnish a uniform, reliable brick, as he used a fireclay that was too refractory, besides having other manufacturing difficulties. These failures made such a bad impression on the city authorities, although made in the infancy of the industry and before any first-class pavers had been produced in this country, that no further effort was made to use brick until 1895. Since then brick has not only become very popular, but to-day is used almost exclusively on the residential and semi-business streets and alleys. Wheeling, West Virginia, put down a fire-clay paving brick in 1883 that was very successful as it inspired confidence. This pavement lasted about twenty years. Decatur, Illinois, also put down a vitrified brick in 1883 that was made from a glacial clay. This pavement was still in use up to a recent date. Galesburg, Ill., the nestor of the shale brick industry, laid the first shale pavement in 1884 on its principal street, where it is still doing excellent service. In 1885, vitrified brick were laid in Columbus, Zanesville, and Steubenville, Ohio, and Peoria, Ill. Since then its use has steadily increased.

The railroad engineers have shown the highest confidence in the ability of vitrified brick to successfully resist the heaviest traffic, as it has been most extensively used by them especially in the Central West for paving freight yards where the teaming is usually of the heaviest nature. They usually draw specifications, however, that admit only the highest grade of brick or block. A table giving the brick paving mileage in a number of the large cities of the United States, also giving the proportion of shale and fire-clay in each city, is as follows:

Cleveland, Ohio: 386 miles; nine-tenths shale, one-tenth fire clay.

Chicago, Ill.: 269 miles; all shale.

St. Louis, Mo.: 196 miles; all shale.

Philadelphia, Pa.: 180 miles; two-thirds shale, one-third fire clay.

Rochester, N. Y.: seventy-nine miles; nine-tenths shale, one-tenth fire clay.

Pittsburgh, Pa.: seventy-six miles; one-half shale, one-half fire clay.

Baltimore, Md.: sixty-seven miles; nine-tenths shale, one-tenth fire clay.

Louisville, Ky.: sixty-seven miles; all shale in late years.

Cincinnati, O.: sixty-six miles; all shale.

Newark, N. J.: fifty-five miles; nine-tenths shale, one-tenth fire clay.

Davenport, Iowa: fifty-three miles; all shale.

Kansas City, Mo.: fifty-three miles; all shale.

Dayton, O.: fifty-one miles; .87 shale, .13 fire clay.

Jacksonville, Fla.: forty-six miles.

Albany, N. Y.: forty-three miles; three-fourths shale, one-fourth fire clay.

Buffalo, N. Y.: forty miles; .71 shale, .29 fire clay.

Grand Rapids, Mich.: thirty-five miles; all shale.

Salt Lake City, Utah: 30.7 miles.

Wilkes Barre, Pa.: twenty-five miles; one-half shale, one-half fire clay.

Preparedness will be or should be the watchword of this country for the next ten years at least. The great powers of Europe, by the expenditure of billions of dollars for the prosecution of the greatest war in the history of the world, will have so exhausted their financial resources that long before the war terminates they will be seeking commercial expansion in new fields. It is a moral certainty that Germany and Great Britain will concentrate their utmost powers to secure additional trade in South America. If the Monroe Doctrine means anything more than a benevolent platitude, this country may be compelled to fight for it. Within a few weeks, one of our leading military authorities made the statement that it would be possible at the present time for an army of one hundred and fifty thousand to effect, a landing at various points on the Atlantic Coast. Preparedness means not only a powerful army and an adequate navy, the establishment of numerous munition plants, additional military and naval schools for the creation of officers, it also means the immediate construction of many thousands of miles of well-built roads, connecting our strategic points along the coasts with interior mobilization camps, munition plants, etc. For the rapid movement and concentration of large numbers of infantry, cavalry, and light artillery, what is more eminently suitable than brick roads? For heavy siege guns, build granite roads.

### CONSTRUCTION DETAILS—MORTAR BED

During recent years, some rather radical innovations to the established practice have been advanced by some brick paving advocates. Mr. Wm. S. Perkins, M. Am. Soc. C. E., in an article in the *Municipal Journal,* gives his views as follows: "The value of the plain sand cushion is being questioned by paving engineers. Many failures occur in brick pavements which can be traced to the non-uniformity of the sand cushion, or to a cushion not properly compacted. Many engineers take the ground that the only function of the sand cushion is to provide a uniform bearing for the brick wearing surface—the smooth, compacted sand taking care of any inequalities of brick or any variation of the foundation." Mr. Perkins believes that the bed of sand should be as small as possible, never more than one inch. It is claimed, says Mr. Perkins, that a grouted brick pavement should have a cushion so as to give it resiliency under traffic. He doubts if sand confined between a concrete foundation and a brick wearing surface has any real elasticity. It may yield, shift, or be compacted by traffic weight on the wearing surface of the pavement, and the cement-grouted wearing surface will of itself; but the sand will not follow and there will be a small air space between the sand and the grouted brick wearing surface. This can easily be demonstrated with a hammer survey of any cement-grouted brick street laid on a sand cushion. The hollow spaces are readily located. These areas become weak spots in an otherwise good pavement and eventually there may be a settling or a breaking

Lecture delivered by William A. Howell, M. S. C. E., Engineer of Streets and Highways, Newark, N. J., in the Graduate Course in Highway Engineering at Columbia University, February 14, 1916.

of the cement bond. Mr. Perkins further states, "In view of all the hazards of using sand for the bedding course, engineers are beginning to turn to the use of a mixture of cement and sand." Mr. Compton, chairman and consulting engineer of the Baltimore Paving Commission, last year made laboratory tests of a cushion mixed 1 : 3, 1 : 5, 1 : 8, and 1 : 10 cement and sand, and adopted for all brick paving work last year in Baltimore a cement sand bed mixed 1 : 5 cement and sand. The sand and cement are thoroughly mixed dry and then handled the same as an ordinary sand cushion. The bricks are then laid, rolled, and inspected, and the pavement wet down for grouting. This adds moisture to the cement-sand bed and eventually the cement-sand bed becomes hard and practically joins the brick wearing surface to the foundation. The rolling of the brick wearing surface is kept up even with the paver. This is an advantage, for if with a cement-sand bed the paving is rolled and not grouted and we have rain, no harm is done; in fact, the rain will set up the cement-sand bed. On the other hand, there is always a hazard when it rains on brick laid on a sand cushion, and not grouted, as the sand is apt to come up in the joints from the wash, necessitating the relaying of sections of the paving. A notable example of the durability of a grouted brick pavement laid on a cement-sand bed is furnished by the paved approaches to the Pennsylvania Railroad Terminal in New York City. These approaches were paved in 1910, the bricks being laid on a cement-sand bed mixed 1 : 3. The pavement to-day shows no signs of deterioration except along the curbs where the wheels of heavily loaded wagons skidding down the inclines have cut into the bricks. The theoretical type of construction is that developed by Mr. W. T. Blackburn, of Paris, Ill., consulting engineer of the Dunn Wire-Cut Lug Brick Company, who, assisted by a local contractor, is laying the brick wearing surface direct on the freshly laid concrete foundation. Mr. Blackburn's specifications for road work in Edgar County, Illinois, using this form of construction, are as follows:

"The foundation shall be four inches in thickness, with its upper surface finished to four inches below the grade of finished pavement and covered over with a thin coating of sand and cement, after they have been first mixed dry, to the depth of three-sixteenths inch. In placing the concrete, the operators shall be guided by a light wood template, resting on side forms, so made as to leave the concrete a little in excess of the depth required. Over this shall be drawn a steel template consisting of a six-inch I-beam in front and a six-inch channel iron to the rear, placed in a frame two feet on centers supported by two rollers at either end resting on the steel forms; the first section or I-beam should be three-sixteenths inch lower than the channel iron and cut the concrete base practically to a true surface four inches below grade. In between these forms must be kept a sufficient amount of sand and cement, thoroughly mixed dry. This rear template distributes this thin film of dry mortar over the surface of the base, leaving the surface entirely smooth. The template is one of the essentials of this type of pavement. Upon this foundation and bedding course the bricks are laid in the usual manner and are rolled with a hand roller weighing not less than twenty pounds per inch of length. The rolling should be kept close to the laying and continued until the surface is smooth. At the end of the working period, the brick laying inspection and rolling shall be completed with the limit of the finished base."

The advantages claimed in using the cement-sand bed, or the new type of construction as developed by Mr. Blackburn, are: Elimination of the hazard of the sand cushion, as the pavement will not be injured at any time by rain, the wearing surface, with the exception of the filler, being completed each day. If a rainstorm intervenes, no damage is done, as there is no sand cushion to become saturated and cause worry about rolling the brick surface. Each brick in the wearing surface will be assured a cement bond its entire depth, for if the cement-sand should work up in the joints it will set up and prevent the shearing action which tends to crush the top of the brick. There is no chance for the bed to shrink or shift away from the bottom of the brick wearing surface, as the brick is firmly bedded in the cement-sand bed or held in the mortar of the concrete base. Where these pavements have been laid, there seems to be a total absence of any rumble under traffic. Slight settlements and breaking of bond due to non-uniformity of sand cushion are eliminated. In reference to the use of cement-sand bed mixed 1 : 5, the increase in cost over a two-inch sand cushion will be from five to six cents per square yard, but Mr. Compton states that in Baltimore there has been no appreciable increase in cost due to its use.

### EXPANSION

The question of expansion in connection with the laying and future maintenance of brick pavements is an all important one. In 1895, in the town of the writer, four brick pavements were laid, two fire clay and two shale. All four of these streets ran north and south. No provision whatever was made for expansion in the specifications. Only one of these streets was laid on a steep grade. Johnson Avenue, laid with Mack Block, blew up at the summit of two fairly steep grades, and some three hundred square yards of pavement was lifted bodily from the concrete, in some instances two feet. This occurred about one year after the pavement was originally laid. The specifications from that time on called for expansion joints along the curbs one and one-half inches wide, and for every fifty feet five rows of brick were to have bituminous filler the width of the roadway. This was afterwards changed to five rows of bricks every twenty-five feet along the length of the street. The city had no serious trouble from expansion for more than ten years during the adoption of these specifications. In order to be in line with many Western cities having large mileages of brick streets, the lateral expansion joints were eliminated from the specifications about four or five years ago, the reason assigned being that they were unnecessary as the longitudinal joints along the curb were sufficient and also for the additional reason that wherever these cross joints were installed there was usually a slight settlement in the pavement producing a low spot.

Last June, on Fourteenth Avenue, Newark, at the intersection of two grades of four and one-half or five per cent., a brick pavement laid with McAvoy Block blew up at the Seventeenth Street intersection of the grades. The cross street was laid with two and one-half inch bitulithic surface on concrete base, but the street intersection was laid with brick. The expansion seemed to creep up the hill westward and lifted about one-half of the entire intersection or a space of about twenty-five by thirty-six feet. The longitudinal joints along the curb were in good condition and were not stopped up with cement grout as is usually charged by friends of this form of joint. There was little or no evidence of pressure on the joints at the curbs. This would seem to indicate that proper provisions had not been made for expansion in this particular pavement. It is to be hoped that solid bituminous strips will soon become available that will help solve this problem, having them inserted both along the curbs and also at intervals across the roadway.

### SAND IN THE GROUTING MIXTURE

While engineers have for many years been striving to bring about the manufacture of better and stronger cement, no concerted effort has been made by the engineering profession to improve the quality of sand; and sand is just as important in the grouting mixture as the cement. The writer has endeavored to get concerted action on this subject that would attain authoritative results for several years. While many specifications make a vague reference to sand being used similar to Ottawa sand, the majority of specifications simply allude to the sand as to permit the use of good, sharp sand, and the contractor dumps on the street sand that is either full of small stones or manifestly ninety per cent. loam taken out of some cellar excavation, and the only test is the perfunctory test of taking up a handfull in the hand. It would give infinite pleasure to the writer to have this matter taken up at an early date, in some practical way. In my native city, the better class of contractors buy boat loads of a good quality of sand known as Cow Bay Sand. This sand has had a good local reputation for thirty years. Other contractors who cannot afford to buy in such large lots, secure sand from some cellar excavation where in one instance good results may be depended upon and from a cellar one hundred feet away on the same street the sand will be practically all loam and absolutely worthless to mix with cement.

### MAINTENANCE

In the matter of street cleaning, by the way, brick pavements are very easily and cheaply cleaned when compared with

some other pavements. A brick street is easily the least dusty type of street among modern pavements. Whether by flushing, or by hand-broom or machine sweeping, the brick pavements are cleaned with a minimum of expense and effort. During the prevailing guarantee period of five years in force, most cities east of the Mississippi River, the question of maintenance does not usually alarm paving contractors in the case of the brick pavements as it frequently does if the paving material were asphalt, asphalt block, or some type of bituminous macadam or bituminous concrete pavement. If a contractor gets his brick from a reliable plant and his concrete is laid properly and the subgrade is well rolled and the grouting is faithfully and intelligently carried out and the weather conditions are favorable, he has practically insured himself from any danger of excessive repairs during the guarantee period and the City is reasonably sure of not being compelled to set aside any large funds for maintenance for possibly ten years' additional time, unless a sudden abnormal increase in traffic conditions occurred on the pavement.

The writer was deeply interested in an article by P. J. Masterson, superintendent of street repairs, Cleveland, Ohio, some points of which are reproduced here. Mr. Masterson says:

"So much of the mechanism of a modern city lies under the surface of its streets that the question of street repair is scarcely less vital than that of good original paving construction, if streets are to be constantly serviceable. The excavator is the worst foe of any pavement, and the efficient repair man its best friend, and will be so long as sewer, water, gas, telephone, and electric power lines are laid in conduits or trenches. Foresight will cut down the number of openings that it is necessary to make in a completed pavement, but no pavement is ever laid in a growing town without the certainty of being disturbed from time to time. In Cleveland, where we have a prepondering mileage of brick streets, it has been necessary to work out careful methods for the replacement of brick paving that has been disturbed. While the process calls for workmanlike exactness, we pride ourselves on patching brick streets so that their strength is unimpaired, and in many instances so that the patch cannot be noticed at casual observation. This is more than can be said for some other forms of pavement. Our first precaution is to have the city relay all of the disturbed pavement. Service corporations and other private concerns are permitted to make openings in streets upon filing proper application. With this application must come a deposit sufficient to cover the cost of replacing the pavement. The city inspects the methods of excavation and particularly dictates the methods of backfilling; but when it comes to the actual repaving, no one but the employees of my department (Mr. Masterson) are entrusted to do the work. The cost is deducted from the deposit and the balance, if any, returned to the party making the excavation.

"I am a firm believer," says Mr. Masterson, "in the policy of compelling the return of all excavated earth to the trench. Only in case of rock excavation could I make any exception. It may be argued that the pipe or conduit takes up a certain amount of space and therefore a corresponding volume of earth may be left out of the trench; but experience shows that, by tamping, more earth can always be returned to a trench than was removed from it, and the practice of requiring it all to be returned leaves no pretext for spongy backfilling, which is a dangerous menace to the security of any pavement.

"In replacing a brick pavement over a trench, we adhere closely to the original specifications used in constructing the pavement, levelling the subgrade and laying, successively, the concrete base, the sand cushion, and the brick. The joint of the completed patch with the original pavement must, of course, be in the original serrated pattern. In making the cuts through the pavement, alternate bricks will sometimes be broken in the middle, leaving a series of broken bricks along the edge of the cut. These half bricks must be "toothed" out with a chisel. We use one about eighteen inches long, so that none but whole bricks remain. It is then possible to break joints in patching. A patch which does not dovetail into the original pavement, but leaves a long, straight longitudinal joint between patch and pavement, cannot be too strongly condemned. A long-handled chisel is the best instrument to use in making the original cut in a pavement. After an opening has been made with a maul, the chisel can be used to cut and pry out each brick separately, making a cleaner opening and facilitating the patchers' job. Matching brick for the patch is an important matter. If the color and age coincide with the original pavement, the patch will be scarcely noticeable. The brick should be carefully measured in matching for size. Where the new brick are a hair's breadth thicker than the old ones, the courses are thrown out of series and good joints are impossible.

"The proper compacting of the sand cushion presents a difficulty that is not found in new jobs of paving. Sand has probably been lost from the original cushion during excavation and it is necessary not only to compress the sand cushion downward in making the repair, but to force it laterally under the edge of the old pavement. For this purpose we use a form of sand rammer, consisting of an iron handle six feet in length, with a rectangular head turned at an angle of forty-five degrees from the line of the handle. This compacts the sand at the edge of the cut and an ordinary wooden rammer or a narrow hand roller does the same service for the width of the patch. Grouting must be done with care and exactness, two to four applications being swept into the joints and the brick swept clean at the last application. The remaining part of the task is simple precaution against disturbances while the grout is settling. The patch should be covered with three inches of moist sand and barricaded for a period of ten days or two weeks. It is a good extra precaution to barricade the entire pavement, where conditions permit, and thus avoid the jar of passing vehicles; but this is rarely possible on the ordinary business street, so the best that we can do is to keep traffic off from the patch during the period of setting. These were the methods used in replacing over forty-two thousand square feet of pavement last year."

Mr. Masterson further states: "Our department deals with many kinds of pavements, and while there are others upon which superficial repairs can be made more easily and promptly, there is none in which the original strength of the pavement is more fully restored than in a brick pavement where there is due care in the workmanship and a careful selection of materials." As brick pavements have been referred, to especially those having cement grout filler, as being exceptionally difficult to repair properly, the statement I have just read from Mr. P. J. Masterson is illuminating.

* * *

## Organization of Road Administration for Michigan

### By Leroy C. Smith, Dep. State Highway Commissioner

Michigan has an area of 58,915 square miles, made up of a northern and southern peninsula. She has eighty-three counties made up of 1,251 organized or political townships.

Almost every condition of development can be found in this State, from land well developed agriculturally, worth from one hundred to two hundred dollars per acre, to wild lands and sand plains. In the southern and western part of the southern peninsula, roads have been laid out from practically every section line in each township, thereby giving the average township seventy-two miles of road.

In the upper peninsula, the main industries are lumbering and iron and copper mining. Most of the roads are angling and are direct roads from one city or village to another. Therefore, the road mileage per square mile is much less than that of the southern peninsula.

Road material is well distributed over the State.

The southern peninsula is largely of glacial origin and good gravel deposits are frequent.

The northern peninsula is supplied with limestone and trap outcrops.

#### TOWNSHIP ROAD UNIT

The organized township is the smallest unit for road administration and improvement in Michigan. It is governed by the township board, composed of the following members: supervisor (assessing officer), township clerk, and two senior justices of the peace. The township highway commissioner, elected annually, is in charge of all township road improvement. He is assisted by an overseer of highways for each district into which the township board may have divided the township.

All taxes for highway work are collected in cash, consisting of a highway improvement tax and a road repair tax, the total

of which is limited by statute to one per cent. of the assessment valuation per annum.

The highway improvement fund of the township is voted annually at a township meeting held in the spring and is spread over all taxable property in the township, including incorporated villages but not cities. The township repair tax is voted at the same time and spread upon all property within the township, outside of incorporated villages and cities.

The highway improvement tax is expended under the direction of the township board by the township highway commissioner. Not more than five hundred dollars may be expended from this fund without first advertising for bids and letting the work by contract.

The repair tax is expended under the direction of the highway commissioner, either by himself or the overseers. Not more than one hundred dollars per mile may be expended from this fund upon any one mile of road per year.

Bonds may be issued by townships for road improvement by a majority vote of the electors qualified to vote at school meetings. No township may bond for a greater amount than five per cent. of its assessed valuation. The usual term of township road bonds is twenty years.

### COUNTRY ROAD SYSTEM

By majority vote of the electors of any county, the county road system may be adopted. Fifty-five counties of Michigan have adopted and are working under this plan of improving the main arteries of travel of the various counties. Under the county road system, a board of county road commissioners, consisting of one, two, or three members (optional with the board of supervisors) is elected. One member of this board is elected every two years for a term of six years.

When established, the board of county road commissioners of each county lays out a system of roads which, in their judgment, should eventually be the complete county road system. This system of roads, mapped out and accompanied by a recommendation for certain roads to be improved during the next year, together with a recommendation of appropriations for the same, is submitted to the board of supervisors of the county. If the board of supervisors approve of the recommendations made by the county road commissioners, they order the county road tax to be spread upon all the property within the county, including the incorporated cities and villages. The county road system recommended and approved by the board of supervisors must meet with the approval of the State Highway Commissioner.

The county road commissioners are empowered to employ a county highway engineer, under whose supervision all road work shall be carried on. Bids must be asked and contracts let for expenditures exceeding five hundred dollars.

When the county road system is adopted in any county, it does not abolish the township unit for road improvement, but relieves the various townships of certain through lines of travel, which are then improved by the county.

Bonds may be issued for county road improvement by a majority vote of the electors of the county. The question of bonding a county may be submitted to a vote by the board of supervisors of the county. The county road bonds usually run for a period of from fifteen to twenty years.

### STATE HIGHWAY ORGANIZATION

The State Highway Commissioner is elected for a term of four years and is the chief executive of the State Highway Department. The State Highway Commissioner is empowered to employ a deputy commissioner who must be a competent civil engineer, experienced in highway building. He may also appoint such other engineers and employees as the work of the department may demand.

The principal duties of the department are as follows:

1. The disbursing of funds appropriated by the State legislature for the payment of State reward and State trunk line reward on roads, built by townships or counties complying with State specifications.

2. Furnishing plans and specifications for the construction of all bridges and culverts used upon State reward roads, and the building of all bridges greater than thirty feet in span upon State trunk line highways.

3. The collecting and furnishing of information relative to the construction of roads and bridges, and the general supervision of all State reward road work.

### ASSESSMENT DISTRICT FOR ROAD IMPROVEMENT

The 1915 legislature passed a law, under which persons owning fifty-one per cent. of the frontage along any public road may petition the road authorities for its improvement.

In counties under the county road system, this petition must be presented to the county road commissioners. In case a road lies in two or more counties, or is on the line between two counties, or lies within a county which is not under the county road system, the petition for the improvement must be filed with the State Highway Commissioner.

Under this law, the cost of improving the road is assessed upon a special district, including all property which receives a benefit from the improvement of the road. An assessment is also made upon the county and township at large. These roads are entitled to State aid when the State specifications and requirements are complied with.

* * *

The best plans for road work are based only to a limited extent on scientific formulas and the results of laboratory experiments. Good judgment, based on wide experience, and careful study of the behavior under service of different types of construction, are also necessary in reaching sound conclusions. Unfortunately, a great deal of road work is directed by persons who do not have this judgment, and waste of money results. Occasionally, absurdities likewise result, such as one described by a correspondent of the *Highway Magazine,* who discovered a new concrete culvert four feet in diameter at the inlet end and two feet in diameter at the outlet end. After puzzling over this curiosity without discovering any explanation of the reason for its unique form, he obtained from a local man this statement: "That culvert was designed to meet local conditions and not theory alone. The road is on the township line and the supervisor having authority on the west side insisted on four feet as about the right size for his end, while the supervisor who had control of the east end thought two feet enough. So the culvert was built to satisfy both."

* * *

Road overseers and supervisors have a hard struggle in many places to keep in even passable condition the roads which run through stretches of low, marshy ground. In spite of all they can do with the side ditches, the amount of water in the adjacent land is so great that every heavy rain causes mud holes. There is an inexpensive remedy for this condition in some cases, a remedy which many farmers are already applying to drain their lands. The accumulation of water is due to an insufficient channel to drain it away, even when there is a winding, choked brook or "branch" through the land. If this channel were straight and free from obstruction to a place where the water would run away readily, the land would be drained. To dig such a new channel is usually too expensive for the farmer or the road overseer, but there is another easier and cheaper way to construct it in many cases. This is to blast a channel though the marsh with dynamite. Occasionally, where the water is held on the surface by a layer of clay a few feet thick, overlying a bed of gravel or other porous material, it is cheaper to blast a large hole through the clay to the porous material. The hole must then be filled with stone, brush, and other coarse stuff, so that the clay will not choke up the outlet for the water.

* * *

The California State Highway Commission announces several important links that are to be added to the State highway system. Two of these links, 5.8 miles in Mono County and 5.6 miles in Ventura County, will be constructed this year by the State. The other three links will all be constructed by the counties which they will traverse, bond issues having been already arranged to provide the necessary funds. These other three links are the San Fernando Road and the Whittier Road, both in Los Angeles County, and the Goleta Boulevard in Santa Barbara County. The Los Angeles County links will be 6.4 miles and 14.1 miles respectively in length, and the Santa Barbara Boulevard will be 7.7 miles in length. All of the roads are important ones, and when paved with the standard type of concrete construction adopted by the State Highway Commission, will be among the heaviest traveled roads in the State. This will add about forty miles to the present State system.

# Better Roads and Streets

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For next year's construction, engineers should begin to gather data from which to determine *the type for the place.*

* * *

*The type for the place,* but where is the place? Is it over a local country road connecting with an inter-county or a main market road, or is the place you are considering constructing next year along a main traveled road leading out of some city, and which must carry intense traffic, enormous tonnage, and to be traveled by heavily loaded motor trucks and through automobiles running at a rate of forty, fifty, and sixty miles per hour?

* * *

If a path made of gravel or stone is sufficient to bear up one mule, then what kind of a road is necessary to bear up six mules drawing a load weighing five tons?

* * *

If a type of a road or street is sufficient to bear up one Ford running at an average rate of fifteen miles per hour, then, Mr. Engineer, what type should you construct sufficient to bear up fifty Packards running at an average rate of fifty miles per hour?

* * *

We wish to remind engineers that the type of a rural road sufficient for an average country traffic of forty vehicles per day, won't last six months under inter-city traffic of three hundred vehicles per day.

* * *

Let us—city and county engineers, city and village councils, county commissioners, and everybody else who has anything to do with contemplated construction of roads or streets for next year—get busy and, from data of the past, service tests, and recent information, come to a sane conclusion and consider, from every viewpoint, the sensible type to be constructed and arrange for the building of *the best type for the place.*

* * *

A trip through the country will prove that gross neglect exists in the care of our country roads. The general condition of the roads is bad enough, but for this there may be some excuse; but when certain places become almost impassable and are allowed to remain in that condition, we say there is gross neglect on the part of the officials in charge.

* * *

If we are to have good roads in the United States, they will come as a result of persistent agitation and education which will convince the taxpayers that such thoroughfares are good investments.

The trouble with most of the taxpayers is that, while they admit that good roads are highly desirable, they have not yet reached that stage which reconciles them to the thought of making that pecuniary sacrifice that is needed to obtain them. As a result, the hands of the public officials are tied, not so much by a lack of desire as by a lack of cash for road improvement.

* * *

The taxes the people of this country pay directly into treasuries is a mere bagatelle compared with what they are losing because of the poor roads.

* * *

A prize of $100, offered by the Barber Asphalt Paving Company to students of highway engineering at Columbia University, has been awarded to Mr. Mortimer L. Neinken, of Brooklyn, for an exhaustive study on the "Comparison and Selection of Roads and Pavements."

* * *

The trouble is not lack of ability to build good roads, but a lack of conviction that they are cheaper than poor roads and well worth the pecuniary sacrifice that is needed to supply them.

* * *

Engineers can prescribe quantities of units for all kinds of types, but the engineer who will specify a certain type without knowledge of the place itself before ordering a particular type to be constructed, ought not be permitted to hold office longer than the voters or the appointing power can put him out of office, for that kind of engineer is unsafe, unwise, and will actually waste a large per cent. of the sum provided by the taxpayers for construction purposes.

* * *

*The type for the place.* If you don't know what the type should be, then look about you and determine what it should be before you proceed with the wrong type and waste a lot of money.

* * *

The road between New York and Philadelphia should cost more money and be of a different type than a road leading from the editor's home town to New Jasper, a settlement with sixteen houses, a county store, and a blacksmith shop, and the road between Jamestown and New Jasper wouldn't last three weeks between New York and Philadelphia; but it would be bad finance, and a punishment, to force the abutting landowners between Jamestown and New Jasper to pay for the construction of a road between Jamestown and New Jasper of the same type and at the same cost of the road between New York and Philadelphia. Thus, you see, *the type for the place* is the first thing to determine.

* * *

There appeared in the June Issue of Better Roads and Streets an article entitled, "The Adaptability of Northern Michigan's Trunk Line Roads for Summer Touring." This article was written and contributed by K. I. Sawyer, superintendent of Ontonagon County, Michigan, with headquarters at Ishpeming. Through an oversight, Mr. Sawyer was not given credit for this article, and we desire that the credit for it should go where it rightly belongs.

* * *

The front cover of this issue is made from a photograph of a motor distributor manufactured by the White Company, Cleveland, Ohio.

* * *

The Board of County Commissioners of Allegheny County, Pa., has awarded contract to the Thomas Cronin Company of Pittsburgh for one and one-half miles miles of Bitoslag pavement.

It was in McKeesport, Pa., which is in Allegheny County, that Bitoslag was laid originally in 1910. The success of the McKeesport pavement, also the success of Bitoslag pavement laid in Philadelphia last year, under heavy traffic, is causing many communities, especially where slag abounds, to look with favor upon this form of pavement.

* * *

The Proceedings of the Second National Conference on Concrete Road Building, held at Chicago February 15-18, 1916, are now ready for distribution. The Proceedings of this conference, published under the direction of the Committee on Resolutions, contains over three hundred pages including all




*West Michigan Pike, Petoskey, Mich.*
*Treated with "Tarvia-B" August, 1915.*

# *A Tarvia County—*

WE sent our Mr. Clark to see the Emmett County Highway Commission, to tell them about Tarvia.

There were many miles of macadam roads in Emmett County which were being churned up into dust by automobiles as fast as they were built. Repair work was incessant and expensive.

Our Mr. Clark said "Paint your roads with 'Tarvia B,' applied rapidly and cheaply from a modified sprinkling cart, and covered with a little sand or stone screening. The Tarvia will act as a tough binder cementing the surface together.

"That tough and slightly-plastic surface thus formed, will be automobile-proof. There will be no dust, no mud and very little wear. The coating can be renewed at small expense and the saving on maintenance will more than pay for the Tarvia. The use of Tarvia won't increase your road expenses—it will reduce them and give you better roads besides."

So Emmett County bought a tank car of "Tarvia-B," and tried it on the above road. October 1, 1915, we received this letter:

> I wish to say that the tank car of "Tarvia-B," purchased through your man, Clark, is doing everything and more for our roads than he claimed. The Board of County Road Commissioners are trying to arrange to use it on all of our improved county roads in Emmett County next year.
>
> Charles W. Lempke,
> Emmett County Highway Commissioner.

On March 23, 1916, the Emmett County Commissioners signed an order for 50,000 gallons of "Tarvia-B" to be used on their macadam roads this year.

There is a grade of Tarvia and a Tarvia process for every macadam road problem.

*Booklets free on request. Address our nearest office.*

### *Special Service Department*

This Company has a corps of trained engineers and chemists who have given years of study to modern road problems.

The advice of these men may be had for the asking by any one interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity the matter will have prompt attention.

## The *Barrett* Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh
Detroit Birmingham Kansas City Minneapolis Nashville Salt Lake City Seattle Peoria
THE PATERSON MANUFACTURING CO., Limited: Montreal Toronto Winnipeg
Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

TRADE B MARK

# Over 30% of the Orders for Thew Shovels are Repeat Orders
## Repeat Orders Indicate Satisfied Owners



WONDERFUL claims will sell almost any machine.

The number of repeat orders received measure the real value of the machine itself.

The rated capacity of The Thew Shovel, like the policy of The Thew Company, is conservative.

Many Thew Owners are securing outputs more than double the rated capacity of the Shovel.

**239 Thew Owners** have been so well pleased with their shovels that they **have given repeat orders. During the past 20 years, 411 repeat orders have been received out of a total of 1300 orders received.**

Other much advertised machines come and go, but verily The Thew goes on forever.

**During the First Four Months of 1916, Forty-Six Repeat Orders Were Received From Thew Owners.**

The latest design Thews are more popular even than the old machines. The same efficient fundamental principles are still employed, but the machines have been strengthened wherever weaknesses have developed and at the suggestion of over 1300 Thew Owners for nearly 25 years. Any up-to-date Thew may be depended upon to deliver maximum outputs with a minimum cost of maintenance, day after day, month after month, and year after year.

Operated by steam, gasoline or electric power.

**Are you familiar with the latest design THEWS?**

**If not, write for Circular 26-B and List of Thew Owners near you. It will pay you.**

# THE THEW AUTOMATIC SHOVEL COMPANY, LORAIN, OHIO


addresses and committee reports. For those seeking unbiased information on concrete highway construction, the Proceedings of this conference represent a compendium of knowledge of inestimable value. The price of this book is one dollar, and all remittances should be made to the National Conference on Concrete Road Building, 111 West Washington Street, Chicago, Ill.

* * *

OHIO CONTRACTORS FORM TEMPORARY ORGANIZATION

A meeting consisting of one hundred or more building and road contractors of Ohio was held in the Virginia Hotel, Columbus, Ohio, June 15, to discuss the advisability of organizing a permanent contractors' association. Mr. H. E. Culbertson, of Cleveland, Ohio, called the meeting to order and stated the objects of the meeting, after which a general discussion followed. A temporary organization was formed consisting of H. E. Culbertson, Cleveland, chairman, and Clifford Shoemaker, Columbus, secretary-treasurer. The chairman was authorized to appoint a committee of ten to draft the necessary by-laws and constitution, which committee is to report at a meeting, which will probably be called within the next thirty days, to complete and perfect the organization. Those present were very enthusiastic and it is predicted that much good will come out of such an organization.

For information regarding the above association, address Clifford Shoemaker, 1136 Walter Street, Columbus, Ohio, or H. E. Culbertson, Citizens Building, Cleveland, Ohio.

* * *

At the Conference of Mayors and Other City Officials of the State of New York, held at Syracuse the early part of June, were a large number of material and machinery representatives. The following well-known personages were noted in attendance at the meetings and around the Onondaga Hotel lobby: J. T. Morris, assistant manager of the Road Department, Philadelphia, Pa.; Arthur H. Putnam, Western New York representative, Syracuse, of the Barber Asphalt Paving Company, Philadelphia, Pa.; Fred C. Davis and Herbert Warren, of Warren Brothers Company, Boston; Stephen Potter, of the Barrett Company, New York City; Louis W. Gay, manager of the Buffalo office, and J. T. Maher, manager of the Albany office, of John Baker, Jr.; E. H. Goodrich, Syracuse manager of the Trussed Concrete Steel Company, Youngstown, Ohio; W. R. Macatee, Syracuse, representative of the Universal Portland Cement Company, Pittsburgh, Pa.; R. R. Stitt, of the Truck Department of the White Company, Cleveland, Ohio; and Thomas H. Mather, formerly Commissioner of Public Works, Syracuse, and now handling a complete line of road machinery and equipment in that city.

* * *

One would think that a road drag cost several thousand dollars from the condition and appearance of some of the earth roads that we have ridden over during the past month in Ohio, Pennsylvania, and New York. Dragging is supposed to be amply provided for in all of these States, but we will wager that not one of the roads that we refer to has, this year at least, had the opportunity to rub elbows with even a split-log drag. There has been plenty of rain this year to use the drag, and if it had been judiciously used on the earth roads, they would be in better condition than ever before.

* * *

An article on the maintenance of the State roads of Maryland was scheduled for this issue of Better Roads and Streets. Due to the fact that we secured the long report of Committee D-4 of the American Society for Testing Materials, which is most timely, the above article is necessarily held over until the August issue. This will be better for several reasons, one of which is its length. The subject of maintenance and the methods employed, the work accomplished, etc., are taken up in detail, naturally making it a description of some considerable length. The question of maintenance is one of the greatest importance, and we have found that highway officials in all parts of the country are eager for information on methods and costs of maintenance in all other parts of the country. Following the article on Maryland will be another one on the maintenance work in Ohio, to be followed by others.

* * *

Plans have been completed for the construction of another high-class service test road. This one will be located on the McDowell Speedway, Lexington, Ky., which will immediately

James Traphagen, county superintendent of highways of Monroe County, New York, has resigned this office on account of poor health, and the announcement is made that he has been succeeded by Louis Moyer, a well-known road engineer of Seneca Falls, N. Y.

* * *

**We repeat it:**

**"A solicitor for road machinery or road materials who goes about knocking everybody else who is engaged in the same line, is only making it harder for himself and everybody else to sell a similar machine or material, and the individual who makes a habit of reporting to his employer that some friend of the employer did not say or do the right thing at the right time is simply building a fire under himself, for in time the employer will find out from his friends who have been criticized by the employee that the employee was depending wholly upon some friend of the employer to land the job and that the employee was wholly inefficient."**

* * *

E. G. Erwin, Union Trust Building, Cincinnati, Ohio, is now the representative of the Asbestos Protected Metal Company, Pittsburgh and Beaver Falls, Pa., and will have charge of all sales of that company, including the new bituminous expansion joint filler that was placed on the market a short time ago. The new filler is used in the construction of concrete and brick roads in transverse joints, and in similar city street pavements as a longitudinal filler along the curbing, as well as for transverse joints.

* * *

Harley H. Fate, President of The J. D. Fate Company, of Plymouth, Ohio, manufacturers of the Plymouth Gasoline Industrial Locomotive and a line of clay working machinery, died in the Huron Road Hospital, Cleveland, Ohio, May 27, 1916. Mr. Fate was forty-two years old. His death followed a minor operation.

Harley Fate was the son of John D. and Mary E. Fate. He was born in Crestline, Ohio, February 19, 1873. When nine years old his father moved to Plymouth, Ohio, where the elder Fate founded the Fate industry which was the foundation of The J. D. Fate Company of to-day, to the presidency of which Harley H. Fate succeeded upon the death of his father in 1902.

The business of The J. D. Fate Company is being conducted by Harry S. Fate, who succeeded his brother as head of the temporary organization; George B. Drennan, secretary-treasurer; H. Ray Sykes, director and acting general manager.

The people of this country are competent to build good roads and to maintain good roads, and while the people of the United States can muddle along in the old rut and still move and live and have their amazing being, we insist they cannot afford to do it.

* * *

A State Highway Commission for Georgia is provided for in a bill that will be introduced in the Georgia legislature, probably, before this issue of Better Roads and Streets is in the hands of our readers. The bill was drawn by Judge Moses Wright, president of the Chamber of Commerce of Rome, Georgia, and Charles S. Davis, former Commissioner of Fish and Game. It has been planned to have the bill introduced by Representative Turner, probably on June 28, the day on which the legislature will convene, although it is possible that it may not be presented for several days after that date.

The bill provides for three commissioners, one of whom shall be the dean of the College of Engineering of the University of Georgia, all of whom are to be appointed by the Governor, and for a State highway engineer, the latter to receive a salary of six thousand dollars per year. The terms of the three commissioners shall be six years, excepting that the first three appointees shall serve for two, four, and six years respectively. The commissioners will be allowed all actual expenses, but they will not receive any salary. The appointment of such assistant engineers as may be necessary is left in the hands of the commissioners. The State highway engineer must be a civil engineer and must also be a road builder of recognized experience.

The State Highway Commission will collect the motor vehicle tax, and it is provided that fifteen per cent of the convicts of the State will be turned over to the commission for work on the roads. The latter provision is being opposed by the prison wardens of the State, who desire to have all the prisoners left under the control of the counties.

* * *

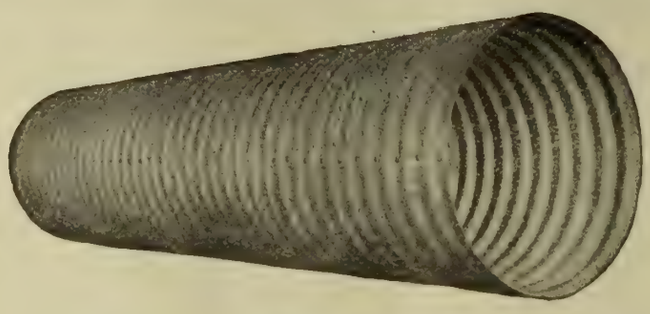
The announcement has been made by the Maryland State Roads Commission that John E. George, of Baltimore, has been appointed assistant to Frank H. Zouck, chairman of the commission.

* * *

The Lee Loader Company, manufacturers of a well-known line of loading devices for road materials, such as crushed stone, gravel, sand, etc., announces that the factory and offices have been moved to much larger quarters to take care of a rapidly increasing business. The concern's new address is 2434 South LaSalle Street, Chicago.



**In spite of the fact that the Garford Motor Truck Company, of Lima, Ohio, has increased its floor space 33 1-3 per cent., the company is still compelled by lack of space to leave much of its output in the open. The above photograph was taken recently near the factory.**



# Wheeling Metal Culverts

Such abstract expressions as "quality," "durability," and "economy" are so overworked that the road builder sees in them but an arrangement of meaningless letters, until he has had experience with Wheeling Corrugated Metal Culverts. Then their significance is so readily understood, it is highly improbable that he ever forgets to specify "Wheeling" when he needs culvert pipe; it makes the road appropriation go further.

**And Wheeling Culverts are made of galvanized Portsmouth Iron even to such details as the rivets.**

Just say "prices" to the nearest address.

WHEELING CORRUGATING COMPANY, WHEELING, W. VA.

BRANCH OFFICES AND STORES:

NEW YORK CHICAGO PHILADELPHIA
ST. LOUIS KANSAS CITY CHATTANOOGA

be reconstructed into a fine boulevard. The work will be under the direction of R. W. Davis, county road engineer, Lexington. The construction will be similar in many respects to the service test roads that have been constructed in Philadelphia and New York City by the highway bureaus, and at Columbus, Ohio, by the State Highway Department. There will be forty sections of road, each two hundred yards in length. Each of these sections will be of a different type of material, or a different brand of the various types, and each section will be laid by the company manufacturing or furnishing the material. Construction will be started about July 1, and it is planned to have the boulevard completed and ready to dedicate at the annual meeting of the Southern Appalachian Good Roads Association, which will be held at Lexington, September 4 to 8 inclusive.

* * *

The Maine State Highway Commission reports that it has been having a busy time for the past month repairing roads that were washed out by the bad storms of last May. There were also a large number of bridges and culverts damaged and destroyed, and these are all being replaced as rapidly as possible. The summer tourist season is now open, and it means a great deal to the thousands of resorts of Maine to have the roads open and in good condition. The season is a comparatively short one, and transportation facilities, with the exception of certain restricted sections, particularly along the Atlantic Coast, are rather poor. The result is, therefore, that much of the summer travel is by automobile. The cities and towns are assisting in this repair and reconstruction work, many of them keeping forces out on the roads day and night. They all realize what it means to business to have these roads in the same excellent condition that they have been for several years past, as the report had gone broadcast throughout the East that touring would not be possible owing to the damaged condition of hundreds of popular highways. The worst damage was done in the southwestern part of the State, and advice just received is to the effect that all roads will be in good condition again by the first of July. Maine, both through her highway department and through the cities and towns, deserves a lot of credit for going at this work with a will, for, as is well known, the State is not one that has a large amount of money available for highway work; but determination, and co-operation between the State, cities and towns, and the hotel men, have saved the profitable summer business for the State. It is only another argument for good roads.

* * *

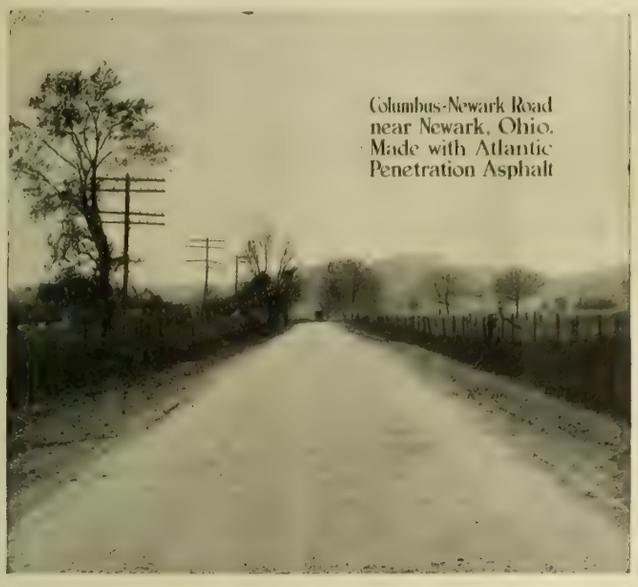
Reports received from the service director of Youngstown, Ohio, show that there has been considerable activity in the office of the city engineer during the past year. F. M. Lillie is city engineer, and Harry Parrock is service director. The annual work of the department of the former in 1915 shows that there was expended on contract improvements the sum of $925,732.11, which was divided as follows:

| | |
|---|---|
| Street paving | $311,608.66 |
| Street repaving | 23,149.67 |
| Sewering | 129,277.19 |
| Grading | 40,617.00 |
| Sidewalks | 70,655.00 |
| Sidewalk repairs | 6,092.00 |
| Cross-walks | 1,078.00 |
| Milton reservoir | 343,254.59 |

The value of all existing street improvements in Youngstown is given as $5,742,380, which is made up by the following items: paving, $3,408,361; paving on good roads taken into the city by acquisition of territory, $444,000; sewers, $1,535,084; grading and guttering, $364,064; sidewalks, $905,771; and bridges, $85,000. Considerable additional paving will be done this year, as well as some resurfacing and repair work.

* * *

The Orenstein-Arthur Koppel Company, located at Koppel, Pa., has placed on the market a motor-driven dump car that can be handled by one man. The new car is equipped with either direct or alternating current motors, and is built for any gauge track from thirty-six inch to standard gauge. The car is certain to become popular with large road contractors as, with its capacity of fifty-four cubic feet, or two cubic yards, it can be economically used for either hauling materials for concrete or macadam road construction, or for making fills and carrying away excavated materials.




# *The* Lowest-Cost Permanent Road

RESISTANCE to the wear of traffic; permanence; attractive appearance; and a smooth, easy-riding surface---all at a low cost ---make the penetration-asphalt road ideal for country highways and suburban streets. Parts of many of the country's most famous highways have been built by the penetration method with

# ATLANTIC
## Penetration Asphalt

The binding and lasting qualities of Atlantic Penetration Asphalt make it the desirable asphalt for penetration roads. It is a Mexican Asphalt, refined from high-grade crude for the definite purpose of producing a road-asphalt of such excellence that it will comply with the most exacting open specification.

Atlantic Penetration Asphalt was applied to the section of the Newark-Columbus Road (in the illustration) by the Atlantic system of pressure distribution, which insures uniformity, smoothness, and added life to the road. Our engineering staff will be glad to discuss pressure distribution with you.

*The* **Atlantic Highway Digest** *is an interesting periodical dealing with highways. It is free. Write for it to-day.*

**The Atlantic Refining Company**

**Philadelphia and Pittsburgh**




# There's a *Right* Machine for *Every* Job in the "Panama Line"

The "Panama Line" is a complete line; it comprises practically everything necessary for the building of good roads. No matter what your road requirements may be you will find a machine to meet them in the "Panama Line."

This line has built for itself an unequalled reputation for mechanical perfection, efficiency and low cost of operation, and each machine that leaves our factory must be worthy of the "Panama Line."

## The "Panama" Giant

This machine is now pronounced, by the best experts of the country, to be the highest type of reversible road machine. For range of work, strength, durability and ease of operation it is unexcelled, and, although built for tractor use, it will stand the strain of continued engine use, and of doing its own plowing.

## The "Panama" Giant with Scarifier

The "Panama Scarifier" which is built into and is really a part of this machine gives two machines in one. The attachment may be used with the blade or drawn up out of the way and the blade used alone. There is no necessity to remove the one while the other is being used, as is the case in other machines.

## The Boston Grader

"The most successful light grader ever produced." Owing to its light weight and small size it will work under conditions and in places where it would be impossible to work a larger machine satisfactorily. The blade can be lowered or raised **easily** from the driver's seat and the machine can be shifted twenty-two inches on the rear axle. It takes but a few minutes work to tilt the blade and you have a most efficient drag.

## The "Panama" Junior

This machine has done more for good roads, and at a smaller cost, than any other small road tool. It is not recommended for heavy work, but for maintaining roads is unexcelled. The blade can be conveniently reversed by the operator to either right or left and the cutting blade raised or lowered.

## The "Panama" Junior Improved

Unlike the "Panama" Junior this machine has a curved moldboard and its roller bearing wheels assure ease of operation for both man and beast. The machine can be worked with or without a tongue and will turn in any space in which a team will.

## The "Panama" Landslide Grader

Among the features that recommend the "Panama" Landslide Grader are roller bearing front and rear wheels on steel shafting, the ease and speed with which the moldboard can be raised or lowered, and the extreme angle at which the blade can be worked.

## Get the "Panama Line" Catalog

MAIL OR USE FOR MEMORANDUM

The F. B. Zieg Mfg. Co. Fredericktown, Ohio.
Gentlemen:-
Send your catalog as offered in Better Roads and Streets.
Name.....
Address.....

And learn **how** and **why** these machines are capable of such exceptionally good work.

Our catalog will give you complete and detailed information regarding the above machines, their construction, and the reasons for their superiority. It will also tell you about "Panama" Culvert Pipe and other road tools belonging to the "Panama Line." If you are looking for the **right** machine for your job, just send for our catalog, and any information you may desire; you'll be glad you did.



THE F. B. ZIEG MFG. COMPANY
*Fredericktown, Ohio*


The general offices of the Jennison-Wright Company, Toledo, Ohio, have been moved to 263 Broadway, where the company has erected a large office building close to the creosoting plant. The company manufactures a creosoted lug and a creosoted plain wood block for street and bridge floor paving, and reports that the business is growing at a rapid rate, and that the old quarters were entirely too small.

* * *

**"It is not for us to undertake to say just what type should be used on the thousands of roads and streets which are being constructed every year, but engineers and officials should determine as nearly as possible just what traffic will go over the particular road or street which is contemplated to be constructed, and then stand up like men and say so, and not 'pussy-foot' around about the job and undertake to make every manufacturer believe that he has a chance for the job and then knock every one of them in the head and suddenly fix a 'type for the place' which was never heard of before."**

* * *

## Oklahoma

THE EXAMINATION OF APPLICANTS FOR THE POSITION OF COUNTY ENGINEER, IN OKLAHOMA

THE Oklahoma Highway Law provides that persons who fill the position of county engineer in Oklahoma shall first pass an examination. The examination is conducted by a board of examiners consisting of three disinterested civil engineers who are appointed by the Commissioner of Highways, subject to the approval of the Governor, and is under the general supervision of the Department of Highways.

In general, it is the intention of the department to conduct these examinations about every six months; the first one was held in September, 1915, when there were seventy-seven applicants, the next in November, 1915, when there were twelve applicants (this one being supplemental for the benefit of those who could not appear the first time), and the last May 22 and 23, 1916, when there were forty applicants. All examinations are held in Oklahoma City, the State capitol, and no person can legally receive a certificate of competency who does not qualify to the satisfaction of the Board of Examiners. So far, it has been the policy of the board to issue permanent certificates to those making a grade of seventy or more and temporary certificates, good for six months, to those making grades from sixty to seventy. Under this ruling, of the first eighty-nine men examined in 1915, thirty-five received permanent certificates and twenty-three temporary certificates.

Of the forty applicants who appeared in May, this year, fifteen received permanent certificates and ten received temporary certificates. In this last class were many men who had either failed the year previous or who had received temporary certificates, and among this number there was a very noticeable improvement in the persons who had made good use of their spare time during the preceeding six months by pursuing some course of home study.

The State University, through Professor Jas. I. Tucker, had compiled a short, non-technical correspondence course on road and culvert construction. Many of the applicants had taken this course and several had completed it so that some credit was given them in accordance with the portion of the course that they had actually completed. Several applicants who had received temporary certificates in the first examination but had made no further efforts, failed completely at the next attempt, as it is also the policy of the examiners to make each test a little harder than the preceeding one in order to raise the standard of efficiency.

At this time, there are a total of fifty who have received permanent certificates and ten who possess temporary certificates issued by the Department of Highways authorizing them to act as county engineers. There are seventy-seven counties in Oklahoma for these men to serve.

In the selection of the Board of Examiners to serve in May, this year, it was the opinion of the Commissioner of Highways that more practical results might be obtained by naming at least two county engineers. Accordingly, Professor Jas. I. Tucker, director of engineering in the State University, was named as chairman and the other two members were T. P.

# BITOSLAG

REG. U. S. PATENT OFFICE

## Contract for one-and-a-half miles of Bitoslag Pavement was recently awarded by the Commissioners of Allegheny County, Pa.

It was in McKeesport, Allegheny County, Pa. that the durability of BITOSLAG was demonstrated by five years service test.

BITOSLAG is an improved asphaltic concrete pavement manufactured by special process, using pulverized slag as the principal mineral aggregate.

BITOSLAG has a gritty surface; is malleable at low temperatures; unaffected by heat; and in every way possesses all the essentials of a high grade pavement.

*For complete information regarding BITOSLAG pavement address,*

## BITOSLAG PAVING CO.

90 WEST ST. - - NEW YORK

Good enough for Uncle Sam




The U. S. Reclamation Service, Indian Agency Service, Lighthouse Service and War Department have used "ACME" Nestables for years. Their record of repeat orders tells a story of service.

"ACMES" resist corrosion and are more than strong enough for all culvert USES—and MISUSES.

*Solve your culvert problems. Send for Catalog G-2.*

THE CANTON CULVERT & SILO CO.
MANUFACTURERS
CANTON, OHIO, U.S.A.

**The Sunbury Automatic Car Unloader**

Highest Efficiency Lowest Operating Cost

Absolutely Automatic on Sand, Screenings, Slag, Stone, Small Coal, or Other Loose Material.

WRITE FOR CATALOGUE.

**THE SUNBURY MANUFACTURING CO.**
SUNBURY, OHIO

C. G. Milburn, Distributor, 600 Columbus Savings & Trust Bldg., Columbus, Ohio

Clonts, of Muskogee, Okla., county engineer of Muskogee County, and M. E. Binckley, of Sapulpa, Okla., county engineer of Creek County. In the first examination held, Mr. Clonts had made the high grade and Mr. Binckley next in rank. Both of these gentlemen have had the advantage of a splendid techical education as well as of years of experience in counties well above the average in Oklahoma in taxable wealth; consequently the questions prepared by them under the direction of Professor Tucker were entirely practical.

The importance of this careful examination and selection of county engineers is apparent when it is known that, in accordance with the highway law of Oklahoma road and bridge construction is under the general supervision of the Department of Highways, which is represented locally by the county engineers. The success of the new law and of the department, therefore, depends to a considerable extent upon the ability of these men; and since the law has now been in effect for twelve months, it is very noticeable that the most excellent results in road and bridge construction are being obtained in those counties fortunate in having efficient engineers, that is, providing always that the engineer must have some business ability and exercise a certain amount of diplomacy to succeed. The greater part of work being done at this time is earth road construction with permanent concrete culverts as a rule, paid for by tax levy. However, at the 1916 special session of the Oklahoma legislature, the law was amended so that counties may now vote bonds for the construction of hard-surfaced roads. Several counties are now contemplating bond issues, the total amount mentioned at this time that may be voted this year will probably reach $4,000,000.

### STATE CONVICT LABOR

There are now five crews of State convicts working on the State roads of Oklahoma divided as follows:

Pottowotomie County—fifty men and seven teams.
Wagoner County—twenty-five men and seven teams.
Bryan County—thirty men and seven teams.
Pittsburg County—two crews, fifty men, no teams.

The law provides that application for the use of State convicts shall be made to the State Board of Affairs through the Commissioner of Highways, provided that all work to be done by the convicts shall be as per plans approved by the Department of Highways. It is therefore anticipated that before convicts are furnished to a county, the county engineer shall have first made surveys of the roads contemplated for improvement and prepared plans, profiles, and estimates for the road and bridge work, these to be presented to the Department of Highways.

The State is to furnish all tools and machinery for the use of the convicts, as well as tentage, housing quarters, and any equipment pertaining to the custody of the prisoners. "The food, clothing, cost of guarding and custody, and the necessary medical attention for convicts in road camps, shall be furnished by the State in the same way and from the same funds as though the convicts remained in the State prison." However, it is further provided that if the cost of feeding the convicts in camp exceeds the cost while in prison, the county shall pay the excess cost.



Monarch Steam Road Roller With Scarifier Attachment.

***Found!***

A Scarifier that not only tears up the surface of worn stone roads, but **planes** the road as well. This scarifier is Simple, Durable, Easily Adjusted to any depth, and is Quickly and Easily folded up so that it does not interfere with the work of the roller.

**It Costs Little. It Does the Work.**

Write today for Catalogue of Rollers and Scarifiers. Furnished free.

**THE GOOD ROADS MACHINERY COMPANY**
KENNETT SQUARE, PENNSYLVANIA

The county must bear the cost of transporting the men, animals, tools, guards, and equipment from the prison or other place where it or they may be, to the place where the work is to be done.

The convict work on the State roads is under the supervision of the county commissioners and the county engineer.

An attempt is being made to keep close data on the amount of work being done by the convicts and the cost of same to the counties. The Department of Highways has not as yet received any detailed reports giving this data, but has the information that in Bryan County the excess cost of feeding the convicts in camp above the cost in prison amounts to about ten cents per day per man. It is roughly estimated that the total cost of the convicts to the county, per man per day, will run about fifty cents.

Applications have been received for convicts from several other counties, and these will be furnished as rapidly as they may be spared from the prison. Owing to a lack of appropriation, the State Board of Affairs is unable to furnish complete equipment with the prisoners, but all counties applying have shown a willingness to provide the necessary equipment that is lacking.

Convict work is proving quite slow, but good and economical results are being obtained. To this date it is reported that among the 155 convicts now working on the State roads, there have been no escapes or attempts to escape. One guard is provided for each twenty-five or thirty men. The convicts wear ordinary clothing with no distinguishing mark except a number on the shirt which is plain but not conspicuous. They appear to be healthy and not averse to the work on the roads.

More detailed reports on the subject of convict labor in this State will be furnished later. Especially good results are expected in Pottowotomie County where the work is being done on the Williams Highway (named after Governor Williams) where the work is being done under the direction of the county engineer assisted by an engineer furnished by the Office of Public Roads of the Department of Agriculture.

ROAD WORK IN GENERAL AND DISTRIBUTION OF STATE FUNDS

Considerable progress in road work is expected throughout the State after July 1 or as soon as the next levy is available. The Department of Highways has distributed to the various counties in the past twelve months the sum of $358,923.18 collected from the registration of motor vehicles, to be used for the maintenance of completed roads, and $67,749.66 from the State Highway Construction Fund to be used for the construction of roads, making a total distribution of $426,672.84 from these two funds. The counties have also expended about $225,000 on road construction out of the county road construction fund.

At the end of this fiscal year, there will be quite a balance remaining in the maintenance fund in many counties that may then be transferred to the construction fund.

Crop prospects all over the State are excellent at this time, so that considerable donation work may be expected. Recently, however, a few of the counties have suffered disastrous floods that have done much damage to bridges and culverts, the most serious damage reported being in Ellis County.





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THE COMING ROADWAY

The only Asphalt Surface furnishing a Safety tread for Horses and Autos. Why?

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State Highway Commissioner of Connecticut nearly eighteen years.
Advice given on all phases of road building and street paving.
Consultations on specifications, materials and methods. Specialty of recommending efficient and economical equipment and plant Accurate estimates for contractors.

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Road Oils
Binders
Petroleum

## The Seventh Annual Conference of Mayors and Other City Officials of the State of New York

(*Continued from page 4*)

"square yard of asphalt pavement" he means exactly the same thing as every other man who uses the term.

A very considerable number of cities do keep their records and receive their bids itemized as described, but they find the undoubted value of this is lessened by the fact that not all use the same units for measuring the work done, or use them with exactly the same meaning.

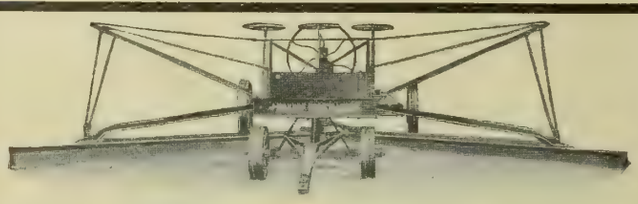
To remedy this condition, the American Society of Municipal Improvements has, after two or three years' consideration, adopted a few of the more important units for paving and sewage, which it recommends as standards for universal use. This society numbers among its members most of the leading city engineers and consulting engineers on municipal work, and it is to be presumed that the units which it adopts will be those best adapted to the purpose which seem practicable at this time. The standard paving specifications which the society has prepared are now generally accepted as the standards for the country, and it hopes that its standard units will also be generally adopted. When each standard kind of pavement is laid by every one according to a standard method and measure with a standard unit, we will then be able to make comparisons which will have a real value—which we are not able to do now.

Possibly some may not think these units so satisfactory as those which they are now using. Perhaps they admit the desirability of a standard, but think that their unit should be adopted; but the general adoption and use of even inferior standard units would be a great improvement over the present condition of no man understanding just what another means. That the units recommended are far from being inferior, would seem to be guaranteed by the high standing of the society which has adopted them.

Mr. Folwell stated also and recommended that if each mayor would direct the departments which have charge of the public works of his city to adopt and use the units referred to, and with the meanings given to them by that society, then each city would know just where it stands in regard to paving and sewerage costs, and whether it is getting as much for its money as its sister cities who use the same units. Then such inconsistencies and meaningless figures as are shown in the tables presented would be a thing of the past, and a very important step would be taken toward greater economy in public work.

The following officers were elected for the coming year: President, Cornelius F. Burns, mayor of Troy; vice president, Walter R. Stone, Syracuse; treasurer, Joseph W. Stevens, Albany; secretary, William P. Capes, New York City; State Municipal Bureau Council: James T. Lennon, Yonkers; D. W. Wilber, Poughkeepsie; H. Clayton Midlam, Troy; James R. Cline, Amsterdam; and Palmer Canfield, Jr., Kingston.

It was decided to hold the next annual conference at Buffalo at a time to be decided upon at a later date.


SEVEN SIZES FRONT VIEW
JUMBO DOUBLE BAR ROAD MACHINE
SCRAPES 30 FEET WIDE IN ONE OPERATION
BUILDS 12 TO 20 MILES OF ROAD PER DAY
N. S. MONROE & SONS ESTABLISHED 1894 ARTHUR, ILLINOIS

APOLLO-KEYSTONE Galvanized Sheets
Made from KEYSTONE COPPER STEEL—Unequaled
FOR ROADWAY CULVERTS
as well as for Roofing, Siding, Flumes, Tanks, and all forms of exposed sheet metal work. Demand APOLLO-KEYSTONE for your Roadway Culverts. Look for the stencil—it insures greatest durability and resistance to rust. Accept no substitute. Write for our free booklet showing actual service tests.
AMERICAN SHEET AND TIN PLATE COMPANY, - - - General Offices: Frick Bldg., Pittsburgh, Pa.

# KOEHRING

SPEED of the charging skip—there's another extra profit bringer to the owner of a Koehring. Note the extreme angle of the skip at charging position—made possible by the Koehring design, which raises the skip right up between the sheaves.

The long skip with gradual slope to side plates prevents clogging and permits rapid and unretarded flow of material into the drum.

The wide loading skip permits rapid and easy charging with wheelbarrow or carts.

Taper grooved winding drums reduce the strain and power required when starting the skip and permits raising of bucket in shortest time—another one of the Koehring features.

An automatic knockout prevents accident when bucket reaches charging position and an automatically applied brake holds the bucket up until released.

***Koehring Sizes in Cubic Feet Capacities.***

Mixers for construction work: 4, 7, 10, 12, 15, 20, 24, 30, 44. Equipped with low-charging hopper, batch hopper and side loader.

Hot mixers for bituminous pavements: 12, 20, 22. Side discharge type and end discharge type.

Paving Mixers: 6, 11, 16, 22. Equipped with distributing boom and bucket or spout.

Gasoline power, steam power, or electric power.

*Write for booklet series D-22, five minute "talks" on construction facts which will aid you in judging mixer values*

**Koehring Machine Company**
**Milwaukee, Wisconsin**

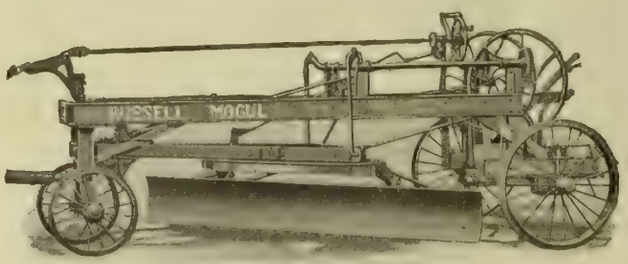


# Russell Road Machines

## A Complete Line of Models For All Kinds of Road Work

Winners of the Gold Medal at San Francisco Exposition 1915. Road Machines for building and maintenance, Elevating Graders, Dump Wagons, Spreader Wagons, Scarifiers, Planers, Plows, Scrapers, Culverts, Steel Beam Bridges, Etc.

WRITE FOR BIG CATALOG.




### The Russell "MOGUL"

The largest, strongest road machine built. Has also the greatest capacity. Weighs 7,000 lbs. Blade 12 feet long, 20 inches wide. For tractor power only. A 60 H. P. tractor cannot overtax its strength. Complete, very simple adjustments. Does "wholesale" road grading most economically.

RUSSELL GRADER MANUFACTURING CO.,
MINNEAPOLIS, MINN.
Representatives In All Principal Cities.

# LITTLEFORD HEATER

## The Proof of the Heater is in the Heating

A Good heater is one which will heat quickly and thoroughly, with **least labor cost** and **least repair expense.** In the Littleford, the kettle is **in** the furnace and is heated directly on all sides. The kettle is removable and easily cleaned. The Littleford is built so it will last longer than any road.

Cast-iron grate-bars
Steel protecting plates
Machined axles
Wide-tired Wheels

**"For the Street Superintendent who wants to show better roads with less taxes."**



**Littleford Bros.**
400 E. Pearl St.
Cincinnati, Ohio

Ask Us About It

TELL 'EM YOU SAW IT HERE.


If culverts are not built of good material, they will have to be rebuilt in a few years, whatever the quality of the roads they are made to serve. Defective culverts vitiate one of the elementary principles of highway economics, and the interests of the taxpayers require that the annual cost of every part of the roads built for their use be reduced to the lowest possible figure consistent with efficiency. Manifestly, it would be worse than folly to build culverts of boards to take care of roads that have cost hundreds or thousands of dollars the mile, and it would be none the less foolish, or worse, to waste money in work of this sort with the use of bad material.

* * *

In building a culvert, the road-builders must observe three fundamental requirements:

1. The first requirement is that the culvert must be so placed that it will drain across the road, and under the road, of course, all the water that is delivered to it by the side ditch along the road. If this be not done, the earth along the road and about the end of the culvert will be wet and soggy the most of the year and the culvert opening will require almost constant repairs. Repairing a highway culvert is relatively more expensive than similar work in a town because of the waste of time of the workmen in going to and from the point at which the work must be done. In placing the culvert, care must also be taken that it will not be choked by brush and leaves, and this duty must be discharged by the road supervisor, and will be if he is worth his salt.

2. The second and very important requirement in the building of a culvert is that its ends must be protected by some kind of wall or facing carried down to a firm foundation. If this be done, it will be found that the end of the culvert will not be undercut by the water and will not be broken, frost will not injure it, the surrounding or superincumbent earth will not slide down into the ditch in front of the opening, and, with the further necessary work of keeping the feeding ditches clear, the culvert will be able to take care of all the water alongside the road.

The third requirement is that the culvert must be made so strong that it will not become broken and so tight that it will not leak. These ends can be reached by building the culvert of masonry, concrete, or of good piping. The material to be used must be determined by the relative cost of the several materials at the locality where the culvert is to be built and by the distance from the top of the culvert to the surface of the road. All technical features of culvert building are explained in pamphlets printed for the use of road supervisors by the highway departments of most States and by the United States Office of Public Roads and Rural Engineering at Washington. These pamphlets can be obtained free of cost upon application so that it is possible for all road supervisors to be their own culvert builders by following instructions. After all, the road supervisor is a most important factor in this work. If he looks after his culverts well, he ought to be retained in office; if he does not, the sooner he can be replaced by one who will do so, the better for the public that uses the roads and particularly for the taxpayers who pay for them.

* * *

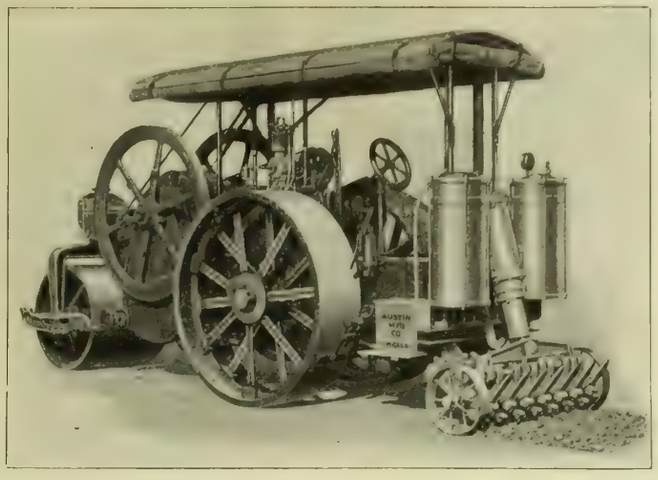
## Brick Roads in King County, Washington

In tracing the history of highways it is not generally known that the first brick pavement on the Pacific Coast was laid in Seattle in 1893, and was in the nature of an experiment for the city to test the serviceability of this class of material. This particular pavement was placed on one of the busiest thoroughfares in the city and is in service at the present time.

In 1895, the city of Seattle started the improvement of other downtown streets, and from that time on, the yardage of brick pavements increased year by year. The first brick road contract in King County was let on May 9, 1912, for 2.75 miles. Aside from the fact that No. 2 brick was used, the specifications aimed at a substantial and permanent highway. The base was of concrete, five inches in thickness, the curbs molded in the same piece. There were longitudinal expansion joints.

# *The Latest Thing in Road Scarifiers*

***The Austin Motor (Kerosene) Roller has received a further enhancement to its high value as a road builder.***



## The Austin Pneumatic Scarifier Attachment

FOR general maintenance work, no greater labor saving device has ever been placed on a road roller. The Austin scarifier utilizes the weight and power of the roller to tear up old road surfaces in the most approved manner. Its movements are entirely controlled by the power of the engine, the teeth or tynes being pulled direct from the roller main frame, while the device is raised and lowered, quickly and simply, by compressed air supplied to the scarifier cylinder from the tanks on either side of same. The air is compressed by a two-cylinder compressor mounted above the engine cylinder and operated from the engine crank shaft.

### *Important Features:*

The operator can control every movement from his position at the roller steering wheel.
The scarifier does not interfere with the regular working parts of the roller.
It can be attached to any standard Austin 10-ton or larger roller.
Every part is accessible; nothing out of reach or out of sight.
The users of this scarifier attachment have endorsed it as a **perfect machine for the purpose.**

*Write for Our New Scarifier Circular.*

## The Austin-Western Road Machinery Co.

**Chicago, Illinois**

BRANCH OFFICES:

New York City Syracuse, N. Y. Philadelphia Atlanta Dallas San Francisco Los Angeles St. Paul

## Plymouth Gasoline Locomotive Pulls Two Box Cars in Test Made by Roadmaster

W. M. Rotroff, roadmaster New York Central Lines (Lake Erie Division) recently hitched a 3-ton Plymouth Gasoline Industrial Locomotive (34 H. P.) to two large automobile box cars, weighing 40 tons, to test out the pulling and traction power. The track was from 1 to 2 per cent. grade.



*From a Photo Taken Day of Test*

### "I Never Saw So Much Power Stored in Such a Small Space," Says Rotroff

"The 'Plymouth' handled those cars with ease" said Mr. Rotroff, "and even pulled them back on the track when they ran off and became imbedded in soft dirt. The friction-drive, which enabled me to 'ease on' the power, and the massive frame did it. I never saw so much power stored in such a small space."

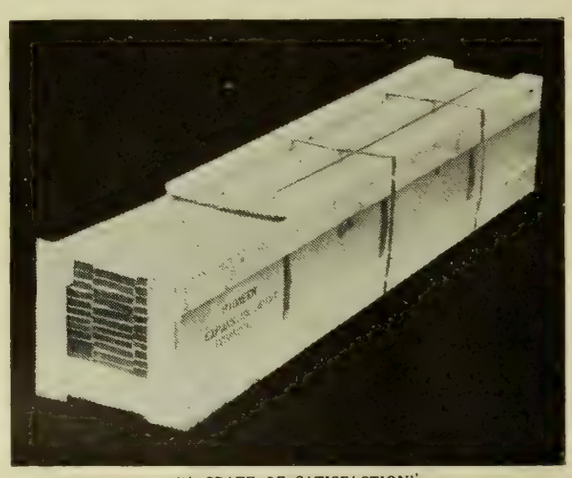
**Plymouth Locomotives Out-pull All Others** There is not a gasoline, electric, steam or compressed air locomotive on the market that can pull the loads the "Plymouth" pulls and do it nearly so economically Five gallons of gasoline and a common day-laborer is all it asks.

**AN EASILY READ PAMPHLET Yours for the Asking** Rotroff's full experience with the "Plymouth" and many others, showing actual cost data, will be sent anyone upon request. It is worth anyone's time reading.

THE J. D. FATE COMPANY

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"A CRATE OF SATISFACTION"

## "PIONEER"

PRE-MOULDED EXPANSION JOINT

Is a quality product which provides for expansion and contraction in brick, concrete or wood block road construction. It is a pure asphalt joint with a woven jute fabric incorporated on each side. "PIONEER" joint is neatly crated as shown in the illustration above, cut to any width or thickness and shipped to the work ready to install in one operation. A new booklet telling more about "PIONEER" is just off the press. A postal will bring your copy with prices and samples.

**The Pioneer Asphalt Co.**

Producers of Highest Quality Bituminous Products

LAWRENCEVILLE, ILL.

PIONEER Highest Quality ASPHALTS

TELL 'EM YOU SAW IT HERE.


This road has given good service and the immediate satisfaction expressed with it led to the adoption of this type of road in 1893 for three jobs undertaken that year. These included 2.9 additional miles on the Pacific Highway, 6.13 miles on the so-called North Trunk Road, and 3.3 miles on the Bothell Boulevard. The contract called for $88,681 in the case of the Pacific Highway extension, for $151,280 in the case of the North Trunk Road, and for $84,918 on the Bothell Road. The first was twenty feet in width, and the others eighteen feet.

With the completion of a third contract on the Pacific Highway in the following spring, a through pavement was given between Seattle and Tacoma, a distance of forty miles. Counts of traffic have shown as high as five thousand vehicles per day on this road, rivaling some of the most-used city streets in Seattle, yet the road exhibits very little sign of wear. The Bothell Road has a traffic approximating three thousand vehicles per day at certain seasons. Its only repairs have been due to the settling of a fill in the subgrade.

The 1914 program also included a contract for 1.64 miles of brick on the Kirkland-North Bend Road. This was an eighteen-foot roadway, laid at a cost of $42,978. It has required no maintenance to date, although at times traffic reaches twelve hundred vehicles a day. At the present time there is under construction 1.4 miles of twenty-foot paving, which involves the expenditure of $52,755.

Mention should also be made of a thousand feet of experimental brick road laid in 1913 by the Denny-Renton Clay and Coal Company, partly at its expense. This is a part of the Pacific Highway and immediately joins the city limits of Seattle.

In all, there are 20.13 miles of brick road in King County, laid at an average cost of $27,900 per mile. In considering this cost, the generous widths should be taken into account and the structural difficulties due to a hilly country. The practice on curves of greater than five degrees has been to raise the outer side of the pavement, and to provide extra width on the innerside. From a scenic standpoint as well as that of easy transit, the roads are a delight to the tourist. The Bothell Boulevard, for example, skirts Lake Washington for nearly its entire length. The practical advantage of these permanent highways outweighs the mere pleasure of travel. There is a constant stream of heavy trucks over many of them, and the freight that they transport has had an appreciable effect upon the volume of railroad haulage.

* * *

## Concrete Roads in West Virginia

One of the most interesting events which has taken place in West Virginia in connection with the movement for improved roads which daily grows in proportions was an inspection trip which was undertaken by the officials of Greenbrier County and prominent citizens through Virginia, Maryland, and West Virginia.

The trip was under the direction of the Portland Cement Association, represented by G. B. Arthur, who is division engineer in this State, and who acted as host to the party. Leaving White Sulpher Springs on the morning of May 22, the party went to Afton, Virginia, on the Blue Ridge in a special car and were met there by automobiles, which took them to Staunton, for lunch.

After lunch the trip was resumed down the Shenandoah Valley to Middletown, where the night was spent at the Wayside Inn. The following day the trip was continued by auto through Winchester, Shepardstown, Frederick, Md., to Washington, D. C., and at Washington the party boarded a special car on the Baltimore and Ohio Railroad for Parkersburg, West Virginia. At Parkersburg the roads of Washington County, Ohio, and Wood County, West Virginia, were inspected, and the business of the trip was completed with a banquet given in the Chancellor Hotel, the party returning home the following day.

The affair was planned to show to the men who will be particularly interested in the building of the roads proposed in Greenbrier County, improved roads of every type which might be seriously considered, and many stops were made to examine the various types under every condition. Particular attention was given to maintenance and the cost of up-keep, noting the efforts which were being made along the roads to be prepared for any emergency.

The party had made up their minds that nothing but permanent roads would be built with the money they had available, and were convinced that any other would be ill-advised and extravagant, but if any doubted the wisdom of this view at the beginning, the piles of stone and barrels of tar deposited along the roads down the Shenandoah Valley, disillusioned them very quickly.

When the party reached Parkersburg it was met by Burdette Woodyard, the county engineer, and representatives of the Board of Commerce, who accompanied them on their inspection of the roads in this vicinity. They were enthusiastic in their praise of the wonderful roads which Wood County has built of concrete, and heartily subscribed to the opinion of the people of Parkersburg, that concrete has solved the road-building problem for Wood County and for West Virginia.

While not so much is heard of the concrete roads in this county as in some others in the country, it is certain that the passing years will give Mr. Woodyard and Wood County a very prominent place in recognition of the comprehensive plan which has grown out of its first steps in the improvement of its roads.

This county took the lead in the State with its first bond issue in 1911, experimenting with several types of roads and finally adopting concrete as the standard type and building them on force account. The results accomplished are sufficient in themselves to recommend to any community the methods used in their construction without considering the fact that they have been built at costs which remove them from competition as hard-surface roads.

The last afternoon of the stay in Parkersburg, the Board of Commerce came and took the party in their cars to see the city, which represents in its activities, a fair example of a city deriving all the benefits of a system of good roads.

That evening the party were entertained at a banquet given in their honor by the host, with members of the Board of Commerce, State Road Engineer, A. D. Williams, and other notable guests present. Mr. Arthur, acting as toastmaster, introduced a number of speakers, who responded enthusiastically, paying many well-deserved compliments to Greenbrier County, Parkersburg, and the Roads in Wood County.

With the improvement of the famous pikes of the State, particularly the Staunton-Parkersburg, Northwestern, and River roads, all of which center in Parkersburg, this city must continue to see direct returns from the State-wide movement for better roads, and the steady extension of the system within the county will give it an enviable position and make it the mecca for inspection parties from within and without the State.

Lewisburg, the county-seat of Greenbrier County, is situated at the junction of the Pittsburgh-Bristol and James River and Kanawha pikes, with the famous White Sulpher Springs just a few miles to the east, in the Greenbrier Valley, which is known widely for its rich blue grass lands and its historical associations, and the improvement of its roads will open a new and wonderful country to the tourist.

* * *

## New Hand Book on Concrete Roads

The Kahn Road Book, devoted to concrete roads and pavements, is the latest production of the Trussed Concrete Steel Company, Youngstown, Ohio.

The first part of the book contains a general historical review of concrete pavements with detailed information regarding particular sections, such as Wayne County, Michigan, and surrounding suburbs. The reports of road commissioners are quoted on the satisfaction of the roads and on questions of maintenance. Tables are shown giving cost data as well as summary of yardage and mileage throughout the country.

The reinforcing of concrete pavements is freely discussed and information on Kahn Road Mesh is included. The necessity and advantage of expansion joints with the necessity of protecting the edges, occupy another section of the book, including in it practical information in regard to Kahn Armor Plates and Installing Device.

Complete specifications with interesting illustrations on concrete highways occupy the next section of the book. The one course concrete highway, the one-course street pavement, and the two-course concrete street pavement are covered by these specifications. Diagrams covering templates, bridges, etc., are included.


# Build Macadam Roads

The macadam road is gaining favor each day.

It is the oldest and best class of road construction in Europe and America.

Thousands of dollars are being spent annually to promote Brick and Concrete Roads, BUT BEAR IN MIND THAT A BRICK ROAD COSTS MORE THAN TWICE AS MUCH AS MACADAM and Concrete increases the cost nearly one-half and neither will wear any longer than a high standard Macadam Road.

Figure the total cost of each road covering a period of twenty years or longer and you will adopt macadam.

Get the facts before adopting your specifications.

Write us for information on stone and slag macadam, water-bound, or treated with asphalt or tar.

We can make delivery of crushed stone or slag in all parts of Northern Ohio, Eastern Ohio, Northern Indiana, and Southern Michigan.

# THE FRANCE STONE CO.

TOLEDO, OHIO

General Office: Second National Bank Bldg


Of interest in connection with pavement construction are concrete curbs with methods of protecting the edges and the installation of these Curb Bars, also the concrete culverts, bridge floors, etc. This information, together with tables giving quantities of materials for concrete and mortar, are included in this general Kahn Road Book.

The Kahn Road Book is issued primarily for engineers and contractors interested in pavement and road construction, including city engineers, contractors, county engineers, road commissioners, etc. To such persons the Kahn Road Book is sent on request by addressing the Trussed Concrete Steel Company, Youngstown, Ohio.

* * *

The following call is the opening gun in a publicity campaign to get the attention of good roads boosters of the Rocky Mountains and the Pacific slope, to a meeting to be held at the Canyon Hotel in the Yellowstone Park, July 24 and 25 of this year, for the purpose of organizing the Park-to-Park Highway.

"For the express purpose of perfecting an organization that will join all national parks in the Rocky Mountain regions and along the Pacific Coast with one good highway to be built by the co-operation of counties, States, and the Federal Government, as proposed by Hon. Stephen T. Mather, Assistant Secretary of the Interior, is hereby made.

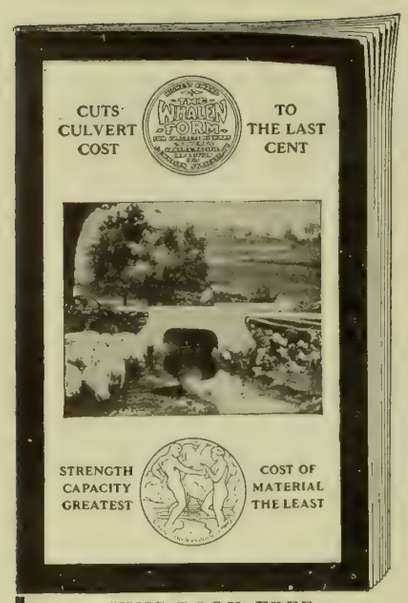
"This call is to representative citizens of Wyoming, Montana, Idaho, Washington, Oregon, California, Arizona, New Mexico, and Colorado.

"This meeting will recognize as delegates all Government, State, and county officials representing the above States, and delegates attending carrying credentials of recognition from the mayor of any city or town, or from the officials of chambers of commerce, automobile clubs, good roads clubs, or any organization devoted to highways or the promotion of automobile travel.

"Meeting will be held at the Canyon Hotel, July 24 and 25 First session will be called at 5:00 p.m., July 24."

* * *

Stanley H. Rose, until recently in charge of the New York office of the Bureau of Foreign and Domestic Commerce of the




# PROOF!

YOU Road Builders are, or should be interested in culvert construction. The most vital question in road building today is, NOT what type of material to use for the surface of the road, or what make of machinery to do the work—but **the one biggest thing in all road construction is, or ought to be, Drainage!** How to get the most water across the road at the least expense and through the most permanent structure—is a question worthy of the best of you.

A NEW BOOK HAS BEEN WRITTEN ON CULVERT CONSTRUCTION. And this book is FREE to interested readers of Better Roads and Streets. The man who compiled the information contained in it probably knows more about this subject than any man in America today. Yet it is all given to you **free for the asking.** The only request is that you mention that you saw this ad in Better Roads and Streets The book does not confine itself to theories—but **is full of facts and figures.** Even if you do not agree with all that is written—tho that is not likely—you will still find the book full of intense human interest. **It will open your eyes**—if it does no more. This is **not** a catalog—it is a free BOOK on the subject of CULVERTS. A cut of the outside front cover is shown above. Now get busy with coupon below.

**THIS BOOK FREE**

SALESMEN WANTED FOR

## THE WHALEN FORM

**401 Vinney Building, Syracuse, New York**

**Use Coupon Below at Once and Get Your Copy of This Book Free Today.**

**Fill out and mail today the Coupon below addressed to The Concrete Form Co., Inc., 401 Vinney Bldg., Syracuse, N. Y.**

*Send me at once postpaid, and with no charge or obligation, a copy of your new Culvert Book*

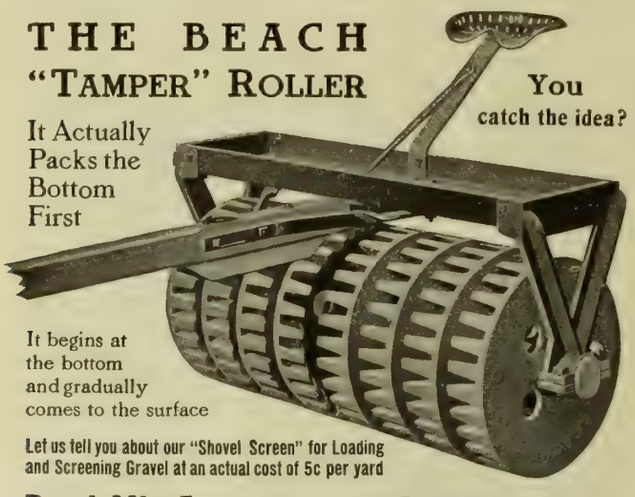
*Name*_____ *Business or Official Title* _____

*Address*_____

## THE BEACH "TAMPER" ROLLER

It Actually Packs the Bottom First

You catch the idea?



It begins at the bottom and gradually comes to the surface

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Department of Commerce, has been engaged by the Barber Asphalt Paving Company to direct its foreign trade department. Prior to his appointment as commercial agent of the bureau, Mr. Rose had had an extensive business experience in the larger part of Europe, Australia, New Zealand, India, and Egypt, and has also held important posts with American and European firms engaged in foreign trade. He is considered an expert in foreign tariffs, trade regulations, and shipping. As special agent of the Bureau of Foreign and Domestic Commerce, Mr. Rose has just completed a tour of more than fifty cities of the Middle West, South, and Southwest, acquainting manufacturers with foreign trade opportunities and advising commercial organizations as to the best methods of promoting export trade. Mr. Rose was educated in London, Berlin, Paris, and Brussels, and speaks most of the modern languages. The Barber Company's export trade in paving materials, roofing, and other asphaltic products, will hereafter be in Mr. Rose's charge, with headquarters in Philadelphia and New York.

* * *

The Jaeger Machine Company, at Columbus, Ohio, builders of concrete mixers both little and big, have issued a new booklet on "Concrete Mixers" describing their line of mixers. The booklet is fully illustrated and full of mighty good mixer information to all persons who are at all interested. Copy will be mailed to parties interested who will request it of the Jaeger Machine Company.

* * *

The Maine Automobile Road Book for 1916 has just been issued for its fifth year by the Maine Automobile Association and is now being sent out to the three thousand members of that organization as well as to the general public. This year's book contains four hundred pages, making it a very much larger volume than the 1915 edition. It has about two hundred and twenty routes, covering all of Maine, the greater part of New Hampshire, most of Massachusetts, as well as New Brunswick and Quebec. A new feature of this year is the through routes between New York City, southwestern New England, and Maine. These are given in both directions. This year's volume has about one-third more routes than any previous edition, and in addition contains the famous Pine Tree Tour now followed annually by hundreds of tourists. A large number of one-way routes of 1915 are this year given in both directions.

A new and decidedly valuable feature this year is a series of fourteen city and town street maps showing the principal entrances and exits. Another new feature is a greatly enlarged general road map showing all of the automobile roads in Maine.

An important contribution is an article on what the Maine State Highway Commission has accomplished and what it intends to do this year, by Paul D. Sargent, chief engineer of the Maine State Highway Commission. Other special features are a digest of the Maine automobile laws, the Maine fish and game laws for 1916, Maine laws regulating the setting of fires on forest and timberland, the department entitled Facts about Maine, greatly enlarged and improved, the through routes of travel put in a form which for simplicity can hardly be equaled, ferry time-tables, regulations for motorists entering Canada, and many others.

The series of indexes are the most complete and most simple to be found in any road book, every minute detail of the volume being covered.

The book is fully illustrated with new pictures and is attractively bound in a green, waterproof leatherette with specially designed covers. It contains three large touring maps enclosed in a pocket in the back of the book, and every point of interest is fully described in the descriptive matter with which the book abounds.

The book is published by the Touring Bureau of the Maine Automobile Association, 12 Monument Square, Portland, Me.

* * *

The Portland Cement Association has recently opened a New York office, which is located in the Architects Building, 101 Park Avenue. With the addition of this office, the Association now has five branch offices, others being in San Francisco, Atlanta, Kansas City, and Dallas. Lewis R. Ferguson is manager of the New York Office; H. E. Hilts manager of the San Francisco office, which is located at 116 New Montgomery




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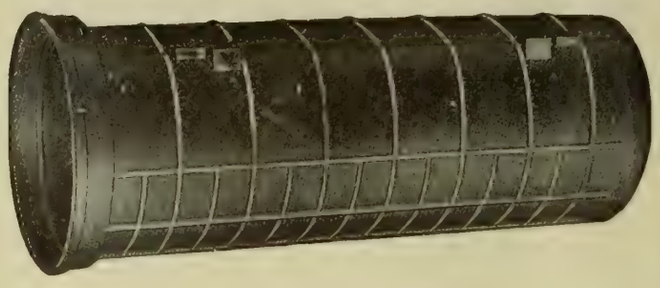
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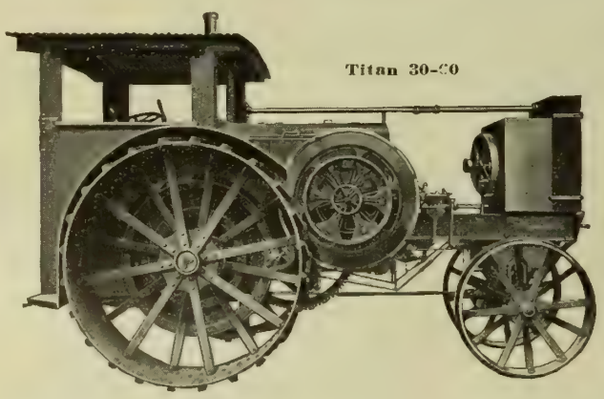
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How much more money would you make for yourself or for your community if you found a way to cut 25 per cent. off your present cost of grading roads? If you are still using horse or mule power, we can show you a way to save even more than that. If you are using a gasoline tractor, we can still show you how to make a profitable saving.

Every dollar you cut the cost of road grading is a dollar added to your net profit. We can put you in touch with one man who says he cut the cost of road grading in Louisiana from $26.00 PER MILE with mule power to $4.50 PER MILE with MOGUL kerosene tractor power. His figures are in the official records of his parish.

That is probably an extreme case, but the fact that so large a saving as this could be made, is interesting. It suggests that possibly your costs are higher than they need be. Perhaps a little investigation would pay. Would you like to see some of the figures we have collected—some of the savings we have helped other contractors and road builders to make by changing over to MOGUL or TITAN kerosene tractor power? They'll cost nothing but a two cent stamp and a little time. Write for them.

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Street; W. B. Elcock manager of the Atlanta office, located in the Hurt Building; J. B. Marcellus manager of the Kansas City office, located in the Commerce Building; Freeman F. Gross manager of the Dallas office, located in the Southwestern Life Building. These branch offices, so advantageously located, considerably facilitate prompt handling of association matters in the territories in which the offices are located as the managers of these offices are practically in charge of affairs in their particular territories.

* * *

By amendment to the constitution of the organization so long known as the Association of American Portland Cement Manufacturers, this organization will henceforth be known as the Portland Cement Association. Headquarters offices are in the Conway Building, 111 West Washington Street, Chicago.

* * *

Rochester, New York, schools devote particular attention to vocational studies and at the present time operate one of the best school shop systems in the United States. The Shop School building is located in Exposition Park and naturally is visited by many teachers and educators who are on sight-seeing trips in Rochester. Although manual training is taught in some of the other schools, all of the advanced work is done at the Shop Schools, which also provide more or less normal training for manual-training teachers.

On Tuesday, May 23, A. J. R. Curtiss, Director of the Extension Division, Portland Cement Association, gave a lecture before the manual-training and vocational teachers of Rochester, on manual training in concrete. The interest in this work is spreading to all sections of the country largely through the facilities which have been afforded by the Portland Cement Association in a well-planned outline with series of lesson exercises, thus making the work very easy for the teachers to put into operation. An idea of the interest which was evidenced by Rochester manual-training instructors, may be gleaned from mention of the fact that practically every manual-training teacher of the Rochester school system was in attendance at Mr. Curtis' lecture. After the lecture, Mr. C. M. Roefer, field demonstrator of the Extension Division of the association, mixed a batch of concrete and showed the process of fence-post manufacture.

Col. Moulthrop, superintendent of the Shop School, announced that courses in concrete work would be maintained next year in both day and evening classes in Rochester.

* * *

The Puritan Machine Company, of Detroit, Mich., owing to the enormous increase of business, has appointed M. R. Hilts as assistant to Frank M. Eldridge, advertising manager, appointment to take place immediately. Mr. Hilts has formerly been connected with the advertising department of the Oakland Motor Car Co., and of the Paige-Detroit Motor Company.

* * *

## Limitations of Tests which Define the Essential Properties of Stone Block, Paving Brick, Wood Block, and Cement Concrete when used in Pavements

(*Continued from page* 8.)

slag, gravel, or other similar material which would be used for macadam construction. As a matter of fact, the concrete in many cases may be simply a macadam whose voids are filled with cement mortar instead of the usual paste of stone screenings and water, or a bituminous material.

Owing to the fact that internal wear of the coarse aggregate in cement concrete is much less than in water-bound macadam, a less resistant to wear stone may be permitted. On the other hand, the greater rigidity of the concrete mass would seem to demand the use of a coarse aggregate even more resistant to crushing than would be permissible in the more elastic macadam.

Returning now to the at present unstandardized or possible tests for concrete, in the effort to see clearly just what should be adopted, let us consider for a few moments the completed concrete itself and some aspects of the situation.

The natural suitability of rock or stone for pavements is generally acknowledged for many reasons. The variation in

suitability of any stone depends upon its characteristics as they may appear in relation to the particular purpose for which it is to be used. Concrete has been, and may be frequently, regarded as an artificial rock prepared under peculiar conditions and with specific ends in view. As the endeavor to reach these ends will be made through such selection of available materials as is permitted by circumstances and when such selection is made, the attempt will, or should be, made to unite the smaller particles into a mass as nearly approaching the solid rock from which the coarse aggregate has originally come as may be practicable. That is, the endeavor will be to have the pieces of coarse aggregate so compacted together and situated in the resulting mass as to have their mass the greatest possible per cent. of the entire body and the otherwise irreducible voids between these coarsest particles filled with the largest possible particles of the same material, and so on down the line until it becomes necessary to fill the smaller voids with mortar, and the finest voids are occupied to the utmost extent possible with the finest suitable material, that is, the cement. Then the entire mass will most nearly approach the solid rock formation desired.

It will be admitted, and can be readily proven, that the densest mass is thus produced and that, other things being equal, the denser the mass, the stronger it will be. Again, the cementing medium will be the weakest element in such a mass, the void-filling media the next weakest, and the coarse aggregate the strongest single element of the entire mass. Consequently, the desirability is evident for having the greatest possible percentage of coarse aggregate in the mass and the least possible percentages of void-filling and cementing media. Applying these principles to the matter in hand, it will be evident that some test for the density of concrete after construction would be enlightening as to its probable strength and other qualities, and it will further be evident that tests alone of the materials proposed to be used for the concrete will not answer this purpose, though they may, to a considerable extent, indicate the possibilities. General adoption of a method for making a density test of concrete has not yet been had, but no doubt when the importance of the matter is properly appreciated, as it should be, a conclusion will be reached.

A compressive test of cylinders from the completed concrete would seem desirable if not necessary and might be very enlightening. Also a rattler test of the coarse aggregate would seem desirable, especially in view of the use to which concrete is now being put, that is, for uncarpeted road surfaces where abrasion takes place to a considerable extent.

The speaker anticipates more or less objections to his suggestions for tests of the completed concrete, especially to his proposition for a test of the density and the implication in his remarks concerning this test that density is to be desired even if obtaining it means a reduction in the proportion of cement used in the mixture. Naturally the cement salesmen and even the cement manufacturers may be expected to resent this suggestion at first, but the speaker wishes to suggest further that possibly a consequent reduction in the proportion of cement will not be ultimately to the disadvantage of these parties. A reduction in the proportion of one of the more expensive elements entering into the concrete might bring about a decrease in the cost of concrete, and if an improvement in the qualities of the concrete should at the same time be had, a sufficiently greater use and adaptation of concrete for various purposes might finally result in a real benefit to the cement interests. In any event, however, the speaker thinks that this audience, as well as himself, is really interested in the truth and not primarily in the commercial interests involved, and that the truth should be sought and exposed at any cost.

Investigations and research work have been done to indicate the correctness of the theories suggested as regard the proper proportioning of the materials for concrete. Some specific work indicates the actual undesirability of a mortar for concrete richer than one part of cement, two parts fine aggregate, and that concretes may with varying proportions of cement, fine and coarse aggregate, show an increase of strength up to about this proportion of cement and fine aggregate and then a descending curve of decreasing strength. The cement interests have frequently stated that the proportion of cement should be approximately fifty per cent. of the amount of fine aggregate and that the proportion of mortar should be between





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Are being used by hundreds of up-to-date contractors, city, township, and county officials. One large contractor in Ohio, who owns two Huber rollers and a couple of other makes, states that he prefers a Huber on account of its easy steaming qualities, abundance of power and freedom from large and expensive repair bills.

We will be pleased to give you full data as well as quote prices on your requirements, if you will drop us a line. Remember, the original Steam Scarifier is found only on a Huber roller.

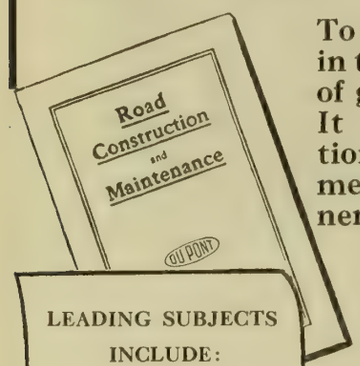
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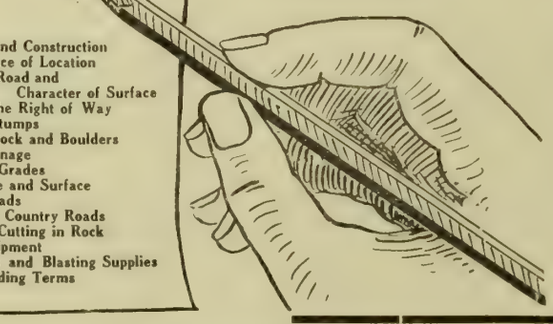
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forty and sixty per cent. of the amount of coarse aggregate, and they say that these figures are arrived at "as the result of experience." Now, what the engineering profession needs to-day is more men in it who will not be content with such a reason. There must be a scientific fact or set of facts underlying any such reason if it is a correct one, and we need the determination and exposition of these facts. The reason may be good. If so, the facts will prove it. On the other hand, it may not be acceptable and the determination of the facts will be conclusive. Engineers need to get at the bottom of things. True engineering needs to know just what it is doing, and that it is not proceeding blindly on a false foundation. This is especially true under modern conditions and those likely to surround us in the near future. The heavier demands on us make it increasingly more necessary to carry our foundations for our work to the bed rock of scientific fact, and should place such limitations on our prescriptions as will be warranted by considerations of safety and demanded by considerations of economy. This institution and this class can materially aid the profession in this regard, and the speaker believes from his knowledge of those connected with both that the highway engineers of the country will not be disappointed in their expectations of them.

* * *

## Review of New York State Work for 1915

(*Continued from page* 17.)

State and every one interested. For this purpose, we have had a field force constantly at work, and we are now better prepared for new work than the Department has ever been in the past.

VILLAGE STREETS

In the consideration of work to be done in the villages, it has been our policy to insist, during the past year, that villages considering paving should first complete their sewage and water systems, and other underground structures in order to avoid the breaking up of the pavement after it has been laid.

Where it has been necessary for a county to build new bridges, it has been our policy throughout the year to get the county to undertake to do its work, if possible, before the contract for road improvement was let, so that on the finishing of our work the road would be complete.

Careful study has been given to the revision of plans with special consideration of the widening of the pavement proper on curves and the giving of greater radius to curves, and the cutting back at slopes and clearing in order to provide better sight distance.

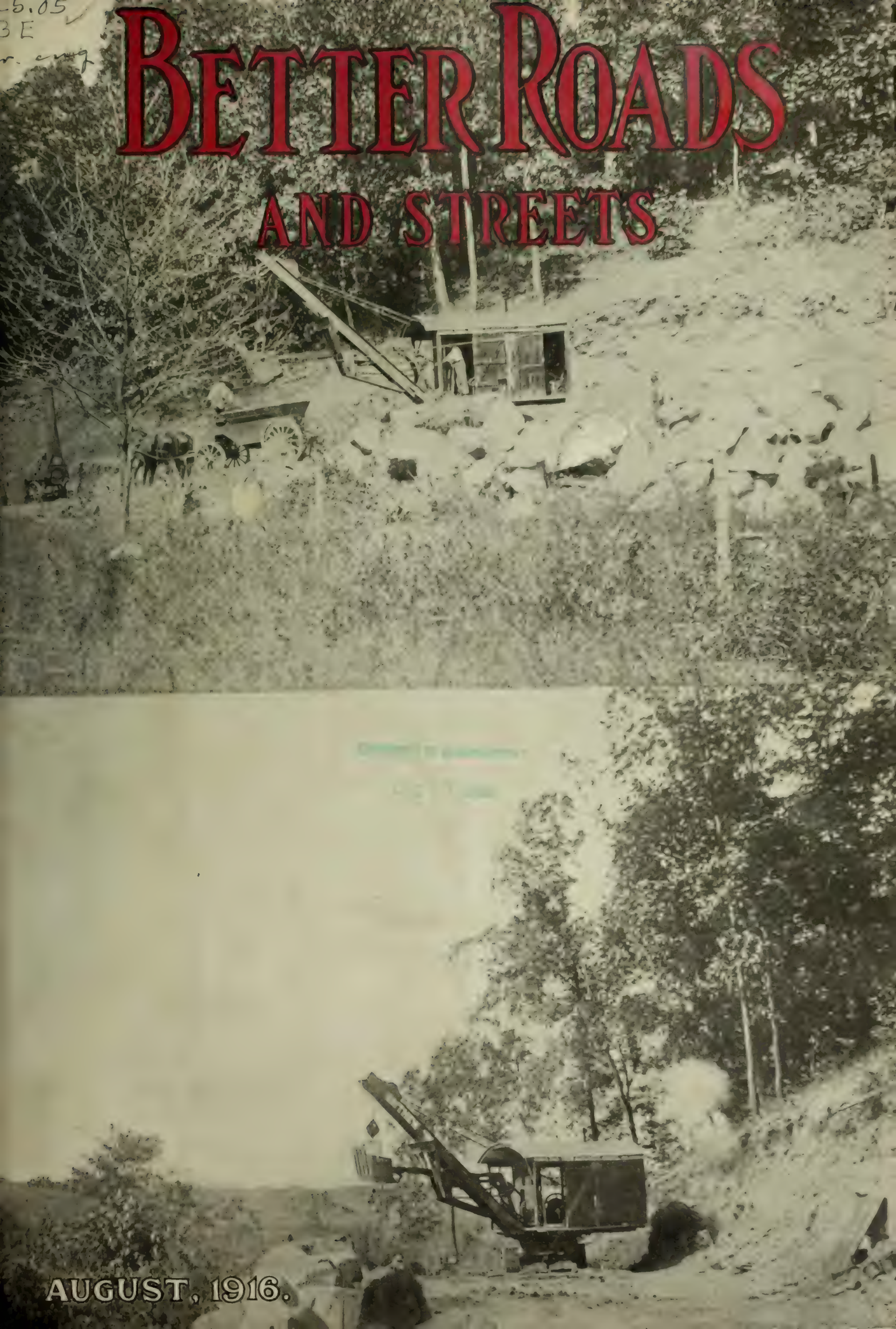
We have broadened out and opened up our specifications wherever we could do so without in any way affecting the quality of the materials to be used, so as to provide for greater competition and to cheapen the cost of the materials to the contractor and to the State.

During the past year we have increased the depth of our pavements because of the large increase in the use of motor vehicles. There were 208,087 pleasure cars licensed in this State in the past year, and 23,585 commercial cars. Motors of both the pleasure and the commercial types seem to be the greatest destructive agents that we have to design against in our highway work. The increased use of commercial trucks and the damage by them to our highways is very alarming; in fact many of our old roads which were built only six inches in thickness have already started to break up under this traffic, particularly at seasons of the year in which the soil under the pavement becomes wet and unstable. At these times, the vibratory action caused by the pounding from impact and the shifting of the heavy moving loads creates such a shear in the pavement as to break its bond. Raveling follows, and unless quickly taken care of, the pavement rapidly disintegrates. As a factor against this, we have been designing our roads of greater thickness, that is, from nine to twelve inches of stone, according to soil and traffic conditions to be encountered. It has also been our policy to build quite a number of miles of concrete roads in the country districts, as these seem to meet more adequately this class of traffic.

In conclusion, I would say that the success of the year passed is due to the loyal co-operation on the part of all the employees of this Department, without which, whatever has been accomplished by the Department would have been impossible.

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# BETTER ROADS AND STREETS



AUGUST, 1916.



Garford Motor Trucks

# This "Switch Engine Garford" Saves Valuable Time for Its Owner

The George Solms Company, large Brooklyn dealers in coal and building materials, are making novel use of their five-ton Garford.

The following letter explains their particular problem and shows how their Garford Truck saves them much valuable time.

> "Perhaps the attached pictures showing how I am using my five-ton Garford may be of interest to you.
>
> "I am a dealer in and handler of coal and building material, and a year ago bought a second-hand Garford Motor Truck, five-ton capacity. It had been used then somewhat over a year, I understood, and I liked the way it worked, so bought it.
>
> "It has given me fine service and is most economical in the use of oil and gasoline and in general upkeep. I don't know what I would do without it. As is often the case in big yards like mine in Richmond Hill, it is necessary to move freight cars loaded with cement or coal or some like heavy material from one part of the yard to another.
>
> "We used to 'pinch' the cars along by hand with a pinch bar, a slow and difficult process. One day a Garford salesman from your office happened along and saw what we were doing. 'Why don't you make your Garford do that for you?' he asked. No sooner said than done! So to-day our splendid Garford servant—almost human it is!—pulls or pushes a car full of material to where we want it, then trundles itself around to the freight-car door and almost loads itself with cement—or whatever it is—and whisks it away to the waiting contractor!
>
> Yours truly,
> THE GEORGE SOLMS COMPANY."

It is Garford stamina, Garford punch, Garford endurance that make such service as this possible.

And YOU can get just as satisfactory results with the Garford in YOUR business—whether it is big or little.

We can supply you with a Garford Motor Truck that will do your work in just the way you want it done.

Write for Information. Please address Dept. 100.

## The Garford Motor Truck Company, Lima, Ohio

**Trucks of 1, 1½, 2, 3½, 5 and 6-ton capacity. Tractors of 5, 7 and 10-ton capacity.**

# Better Roads and Streets

VOL. VI. NO. 8. AUGUST, 1916 PRICE FIFTEEN CENTS

## It Is a Law

Signed by President Woodrow Wilson, July 11, 1916.

An Act to Provide that the United States Shall Aid the States in the Construction of Rural Post Roads

The Committee of Conference of the two houses of Congress on H. R. No. 7617, known as the Shackleford Bill, and the amended House Bill, known as the Bankhead Bill, reported to both houses on June 27, 1916, and on that day both houses adopted the report of the conferees and the bill went to the President for his signature.

The following is a complete copy of the law and should be carefully read and kept for reference:

Sec. 1. That the Secretary of Agriculture is authorized to co-operate with the States, through their respective State Highway departments, in the construction of rural post roads; but no money apportioned under this act to any State shall be expended therein until its legislature shall have assented to the provisions of this act, except that, until the final adjournment of the first regular session of the legislature, held after the passage of this act, the assent of the governor of the State shall be sufficient. The Secretary of Agriculture and the State Highway Department of each State shall agree upon the roads to be constructed therein and the character and method of construction: Provided, That all roads constructed under the provisions of this act shall be free from tolls of all kinds.

Sec. 2. That for the purpose of this act, the term "rural post road" shall be construed to mean any public road over which the United States mails now are or may hereafter be transported, excluding every street and road in a place having a population, as shown by the latest available Federal census, of two thousand five hundred or more, except that portion of any such street or road along which the houses average more than two hundred feet apart; the term "State Highway Department" shall be construed to include any department of another name, or commission, or official or officials, of a State empowered, under its laws, to exercise the functions ordinarily exercised by a State Highway Department; the term "construction" shall be construed to include reconstruction and improvement of roads; "properly maintained" as used herein shall be construed to mean the making of needed repairs and the preservation of a reasonably smooth surface considering the type of the road; but shall not be held to include extraordinary repairs, nor reconstruction; necessary bridges and culverts shall be deemed parts of the respective roads covered by the provisions of this act.

Sec. 3. That for the purpose of carrying out the provisions of this act there is hereby appropriated, out of any money in the Treasury not otherwise appropriated, for the fiscal year ending June 30, 1917, the sum of five million dollars; for the fiscal year ending June 30, 1918, the sum of ten million dollars; for the fiscal year ending June 30, 1919, the sum of fifteen million dollars; for the fiscal year ending June 30, 1920, the sum of twenty million dollars; and for the fiscal year ending June 30, 1921, the sum of twenty-five million dollars. So much of the appropriation apportioned to any State for any fiscal year as remains unexpended at the close thereof shall be available for expenditure in that State until the close of the succeeding fiscal year, except that amounts apportioned for any fiscal year to any State which has not a State Highway Department shall be available for expenditure in that State until the close of the third fiscal year succeeding the close of the fiscal year for which such apportionment was made. Any amount apportioned under the provisions of this act unexpended at the end of the period during which it is available for expenditure under the terms of this section shall be reapportioned, within sixty days thereafter, to all the States in the same manner and on the same basis, and certified to the Secretary of the Treasury and to the State Highway departments and to the governors of States having no State Highway departments in the same way as if it were being apportioned under this act for the first time: Provided, That in States where the constitution prohibits the State from engaging in any work of internal improvements, then the amount of the appropriation under this act apportioned to any such State shall be turned over to the Highway Department of the State or to the governor of said State, to be expended under the provisions of this act and under the rules and regulations of the Department of Agriculture, when any number of counties in any such State shall appropriate or provide the proportion or share needed to be raised in order to entitle such State to its part of the appropriation apportioned under this act.

Sec. 4. That so much, not to exceed three per centum, of the appropriation for any fiscal year made by or under this act as the Secretary of Agriculture may estimate to be necessary for administering the provisions of this act shall be deducted for that purpose, available until expended. Within sixty days after the close of each fiscal year, the Secretary of Agriculture shall determine what part, if any, of the sums theretofore deducted for administering the provisions of this act will not be needed for that purpose and apportion such part, if any, for the fiscal year then current in the same manner and on the same basis, and certify it to the Secretary of the Treasury and to the State Highway departments, and to the governors of States having no State Highway departments, in the same way as other amounts authorized by this act to be apportioned among all the States for such current fiscal year. The Secretary of Agriculture, after making the deduction authorized by this section, shall apportion the remainder of the appropriation for each fiscal year among the several States in the following manner: One-third in the ratio which the area of each State bears to the total area of all the States; one-third in the ratio which the population of each State bears to the total population of all the States, as shown by the latest available Federal census; one-third in the ratio which the mileage of rural delivery routes and star routes in each State bears to the total mileage of rural delivery routes and star routes in all States, at the close of the next preceding fiscal year, as shown by the certificate of the Postmaster General, which he is directed to make and furnish annually to the Secretary of Agriculture.

Sec. 5. That within sixty days after the approval of this act, the Secretary of Agriculture shall certify to the Secretary of the Treasury and to each State Highway Department and to the governor of each State having no State Highway Department the sum which he has estimated to be deducted for administering the provisions of this act and the sum which he has apportioned to each State for the fiscal year ending June 30, 1917, and on or before January 20 next preceding the commencement of each succeeding fiscal year shall make like certificates for such fiscal year.

Sec. 6. That any State desiring to avail itself of the benefits of this act shall, by its State Highway Department, submit to the Secretary of Agriculture project statements setting forth proposed construction of any rural post road or roads therein. If the Secretary of Agriculture approve a project, the State Highway Department shall furnish to him such surveys, plans, specifications, and estimates therefor as he may require: Provided, however, That the Secretary of Agriculture shall approve only such projects as may be substantial in character and the expenditure of funds hereby authorized shall be applied only to such improvements. Items included for engineering, inspections, and unforeseen

(Continued on page 48)

# State Highway Maintenance in Maryland

IN the June issue of Better Roads and Streets we took up the work of the Construction Department of the Maryland State Roads Commission, showing what has been accomplished during the past two years in this progressive State toward the construction of a complete State highway system. This article will, therefore, deal with the subject of maintenance b ythe Maryland Commission on the roads that have been completed.

Under the rapidly changing traffic conditions in Maryland, the maintenance of the modern roads that have been constructed at considerable expense is no less important than the actual construction of these roads was in the first place. This is especially true when it is taken into consideration that the construction can be deferred, while the maintenance, after the roads have once been constructed, cannot be put off excepting to the serious detriment of the newly constructed road. This fact has been consistently recognized and kept in mind by the Maryland commission and its chief engineer, Henry G. Shirley, from whom the material contained in this article was obtained. The Maryland commission has been alert in keeping the roads up to the highest standard so that they compare very favorably with the highest types of roads that have been built in other States. The completion of the Maryland State Road System will be effected this year, and much care and study have been given to the subject of maintenance, and to the building up of an organization that will be capable of taking care of the roads in future years at a minimum cost. The ideas of the engineering division of the State Roads Commission will, therefore, be combined with the methods that have been worked out and which are in vogue throughout the State today, as in nearly all cases they are one and the same thing.

The commission is of the opinion that, soon after having been completed, all macadam roads should receive a treatment of asphalt or tar, upon which is placed a covering of sand, gravel, or stone chips. Otherwise the surface cannot be preserved from the ravages of motor cars, motor trucks, and busses. In other words, a newly constructed macadam road should not be considered really ready for traffic until its surface has been so treated. This type of road should also really be oiled before it is accepted by the State, but it seldom happens that the contractor who builds the road is equipped for doing this oiling. In theory, the macadam road should be completed in the spring or in the early summer so that it can be oiled as soon as the weather is warm enough to secure the proper penetration of the oil. But in practice this type of road is generally finished late in the summer, or in the fall or even early winter, when it is too cold to oil the road properly. The public then insists upon the road being opened to traffic without this protection, and then before it can be oiled the following summer, the road is frequently starting to pick up, and in some cases, it has started to go to pieces. The road then has to be rolled down and put in good condition again, necessitating considerable expense, before it can be oiled or treated with asphalt or tar. This objection does not apply to concrete roads, and it will be obviated when construction is over.

Maryland has paid a great deal of attention to oiling the roads, and has some excellently maintained roads as a result of this method. An idea of what has been done along this line may be had from the following figures by years, taken from the maintenance records:

1908-1909. No oiling was done during these two years, owing to the fact that there was no completed State road mileage.

1910. The first oiling was done this year, the roads having been completed during the previous year. Thirty-eight miles of road were oiled, requiring 140,000 gallons of oil. This mileage was almost entirely covered with a local sand or gravel, which was obtained and spread at a very low cost.

1911. One hundred miles of road were oiled this year, requiring 400,000 gallons of oil. All excepting about twenty miles was covered with local sand and gravel.

1912. There were 178 miles of road oiled during the year, requiring the use of 602,000 gallons of oil. The roads oiled were covered with 2,500 tons of trap rock or limestone chips. The oiling operations this year had to be started late in the season, and the only equipment available consisted of one automobile pressure distributor with some horse-drawn distributing wagons. While local sand or gravel could generally have been had at slight expense for covering, it was found that these materials were generally of a poor quality and that much better results were secured by importing stone chips, although this added materially to the cost of the work.

1913. During this year there were 317 miles of roads oiled, about 1,000,000 gallons of oil having been used. This was covered with 12,500 tons of stone chips. The results this season were much more satisfactory, especially on the Eastern Shore and in central Maryland. This was due to awarding the oiling contracts in sixteen counties to two large oiling concerns, and by purchasing a motor truck fully equipped for oiling. This truck was used by the State Roads Commission to do such work as could not, for local or other reasons, be given out under contract. There were, this year, seven large pressure motor distributors operating on the State road system at one time. The State truck was convertible, with two bodies, one of which was used for oiling and the other for hauling stone chips, gravel, etc., when it was not needed for oiling work. During 1913, stone chips or washed gravel were used almost exclusively for covering the oiled roads, excepting in a few cases where a satisfactory local gravel was found.

1914. There were 448 miles of road oiled this year. This required 1,427,000 gallons of oil and 25,250 tons of stone chips. With the experience that had been gained in previous years, it was decided this year to do all oiling and all surface treatment work by contract. With this object in view, specifications were prepared during the winter months, and the State was divided into eight geographical divisions, on each of which bids were requested as separate units. The contractors were this year required to furnish and apply all material, to submit a gallon sample of the material they agreed to use, and to guarantee that all material to be shipped in during the season was to be as good as the sample submitted at the time of bidding. This plan of calling for proposals proved highly satisfactory. Bids were opened on February 26, with keen competition, there having been a total of ninety-eight bids received to furnish and apply ten different materials. The contracts were awarded as follows and at the unit prices given for the eight divisions.

| Division | Contractor | Miles to be oiled | Gallons oil req'd | Contract price |
|---|---|---|---|---|
| 1. | United Gas Improvement Co. | 48.10 | 120,843 | $ 9,491.57 |
| 2. | United Gas Improvement Co. | 27.67 | 83,260 | 6,463.29 |
| 3. | Walter Cressy | 43.98 | 109,827 | 8,894.00 |
| 4. | Walter Cressy (Part) | 44.12 | 146,786 | 11,311.38 |
| 4. | Barrett Manufacturing Co. (Part) | 19.16 | 61,957 | 4,292.61 |
| 5. | Good Roads Company | 67.82 | 199,022 | 14,329.57 |
| 6. | Sands-Kline Company | 69.64 | 204,280 | 15,884.18 |
| 7. | Barrett Manufacturing Co. (Part) | 66.48 | 205,885 | 15,192.00 |
| 7. | Good Roads Company (Part) | 5.28 | 16,520 | 1,122.25 |
| 8. | Barrett Manufacturing Company | 19.72 | 45,354 | 3,487.72 |
| | Totals | 412.87 | 1,192,734 | $86,175.96 |

The following tabulation shows the number of gallons required per mile of road and the average cost of oiling per mile in each of the eight divisions by contractors, the arrangement being the same as in the preceding table.

| Division | Gallons oil required per mile | Average cost of oiling per mile |
|---|---|---|
| 1 | 2,512 | $197.32 |
| 2 | 3,009 | 233.58 |
| 3 | 2,497 | 202.22 |
| 4 (Part) | 3,304 | 256.37 |
| 4 (Part) | 3,233 | 224.03 |
| 5 | 2,896 | 208.52 |
| 6 | 2,933 | 228.08 |
| 7 (Part) | 3,096 | 228.51 |
| 7 (Part) | 3,128 | 212.54 |
| 8 | 2,299 | 176.86 |
| Averages per mile | 2,888 | $208.72 |

Because of the milder weather conditions, these oiling operations were commenced the first week of May in the extreme southern counties of the State, and later in the same month in all the other divisions of the State. The contractors were under penalty to complete their contracts in eighty days, and not later than September 1, which was done in every case.

Such roads as were finished by the construction contractors after the oiling contracts were awarded were treated later in the season, these approximating twenty-two miles, and requiring about 100,000 gallons of oil and 1,500 tons of stone chips. All such roads were treated with one-half gallon of

bituminous material per square yard, and with but one or two exceptions they went through the winter in excellent condition.

Eight automobile pressure distributors were employed in applying the oil or tar in 1914, and, when help was requested, help was extended to the various counties of the State in treating their State-Aid roads. In such cases, an experienced State Inspector was placed in charge of the work.

In this year a card system was developed and introduced. This system shows in detail the costs of all surface treatment, the pounds of chips used per square yard in the covering process, etc. This data has proven very valuable in handling the work, and will be of even greater value for future comparisons.

In order that the progress of the operations could be followed closely and quickly in the office of the commission in Baltimore, a large map of the State was prepared. This map showed all contracts which were to be treated. Brass tacks were used on this map to locate the automobile distributors, while red tacks were used to show all contracts that had been completed. An oil inspector accompanied each distributor, and he was required to send daily into the Baltimore office report cards covering the work done each day, and reporting where the truck would be working on the following day. From these cards the position of the distributors was noted with the brass tacks each day on the map, and at the end of the season the red tacks on the map showed each contract that had been treated.

1915. During 1915, there were 504 miles of road oiled, 1,500,000 gallons of oil and 32,500 tons of trap rock and limestone chips being required. This year the State was divided into seven divisions instead of eight, and bids for the surface treatment were opened on March 16. Bids were received from more divisions, but also for the work to be done throughout the more divisions, but also for the work to be done throuhgout the entire State. The oiling contracts were awarded as follows:

| Division | Contractor | Miles to be oiled | Gallons required | Contract price |
|---|---|---|---|---|
| 1. | United Gas Improvement Co. | 56.98 | 150,197 | $ 9,689.80 |
| 2. | Atlantic Refining Company | 61.96 | 156,037 | 7,058.56 |
| 3. | Good Roads Company | 83.72 | 238,502 | 14,258.06 |
| 4. | Good Roads Company | 90.73 | 225,231 | 12,932.00 |
| 5. | Sands-Kline Company | 79.61 | 205,676 | 14,287.41 |
| 6. | Headley Good Roads Co. (Part) | 31.27 | 100,000 | 6,134.55 |
| 6. | Barrett Manufacturing Co. (Part) | 27.88 | 68,606 | 5,280.49 |
| 7. | Barrett Manufacturing Co. | 34.14 | 84,832 | 5,730.11 |
| | Totals | 466.29 | 1,229,081 | $75,370.98 |

There was a marked saving in the cost of oiling the roads as compared with the previous year. The records show that the average cost per mile was $161.64 in 1915 as against $208.72 in 1914. In the former year, 2,636 gallons were averaged per mile, and 2,888 in 1914. The number of gallons put on the roads and the average cost per mile for oiling, according to the seven divisions, was as follows:

| Division | Gallons oil required per mile | Average cost of oiling per mile |
|---|---|---|
| 1. | 2,636 | $170.05 |
| 2. | 2,518 | 113.92 |
| 3. | 2,848 | 170.30 |
| 4. | 2,482 | 142.53 |
| 5. | 2,583 | 179.46 |
| 6. | 3,197 | 196.18 |
| 6. | 2,460 | 189.58 |
| 7. | 2,484 | 167.84 |
| | Averages 2,636 | $161.64 |

In 1915, it was decided, after it had been found so satisfactory in advertising for bids for oiling, to also advertise for bids on hauling the stone chips, as the quantities required annually had now reached large proportions. The State was therefore divided into sixteen divisions, specifications were prepared and estimates asked for. This was done early in the year when the contractors had little or nothing to do, the bids being opened on March 22. Bids were received from fifty-three contractors, some of them bidding on several divisions and others on the hauling throughout the entire State. The large number of bids was surprising, and included a number of local county contractors and liverymen who submitted bids on the work in their respective counties. It is conservatively estimated that the State saved about $8,000 by letting the work under contract. The contracts covered the hauling and delivering of 18,152 tons of chips, at an average price throughout the State of $0.23414 per ton mile. An average of 58.09 tons of chips were delivered and spread per mile, and the average cost per mile for hauling and delivering was $37.59.

The quantity of stone chips used per mile was increased in 1915 to sixty-five tons, and for the first time, the surface was rolled. A ten-ton roller was used for this purpose, and the chips were rolled in on every contract oiled in 1915. This added to the expense of applying the surface treatment, but experience has shown that this increased cost is justified by the superior wearing surface obtained, and that by this method, larger stone chips can be used, when necessary, on roads where the traffic is very heavy. Stone chips an inch in size were put on in many places, and when they were rolled in, gave a most excellent surface, and one that had fine wearing qualities. The proportion of stone chips used will be still further increased this year in this class of work, and a combination of the large and small sizes will be used, particularly on the heavy traffic roads. The large chips will be spread on first and rolled in, after which the layer of pea stone will be spread and rolled.

The following itemized table of the cost of applying this surface treatment by years will be found of considerable interest, as seldom are such figures obtainable from an official and reliable source.

TABLE NO. 1.
MAINTENANCE OPERATIONS BY YEARS.

| Year | Miles of road oiled | Total cost of oiling | Average cost of oiling per mile including stone chips | Total tons of stone chips used | Average tons of stone chips used per mile | Total gallons of oil used | Average number gallons used per mile | Est. cost of stone chips per mile applied | Est. cost of oil per mile applied without stone chips |
|---|---|---|---|---|---|---|---|---|---|
| 1910 | 38.40 | $ 14,393.31 | $374.82 | 166.68* | 4.3 | 140,239 | 3.652 | $ 8.68 | $366 14 |
| 1911 | 100.39 | 36,526.42 | 363.84 | 1,057.10 | 10.5 | 400,423 | 3.988 | 16 25 | 347 59 |
| 1912 | 177.85 | 63,795.64 | 358.70 | 2,572.08 | 14.5 | 602,082 | 3.386 | 46.83 | 311.87 |
| 1913 | 317.23 | 111,245.11 | 350.67 | 12,571.88 | 39.6 | 999,009 | 3.149 | 124.47 | 266.20 |
| 1914 | 448.14 | 162,879.92 | 363.45 | 25,251.64 | 56.3 | 1,427,388 | 3.185 | 133.11 | 230.34 |
| 1915 | 503.78 | 176,972.29 | 351.28 | 32,429.93 | 64.4 | 1,444,712 | 2.867 | 142.21 | 209 07 |
| Total | 1,585.79 | $565,812.69 | $356.80 | 74,049.31 | 46.7 | 5,013,853 | 3.161 | $ 78.59 | $281 87 |

THE PATROL SYSTEM OF MAINTENANCE IN MARYLAND

A patrol system of maintenance has been developed, extended and improved, and much has been done on this organization to perfect it. It requires experience, instruction, and special knowledge to patch, repair, and properly maintain a macadam road, and it takes time to secure competent men to do this work as it should be done.

The patrolman is supplied with all the necessary small tools, a tar bucket, oil, stone chips, etc., to take care of the surface of the roads in the section to which he is assigned. He is furnished with a cap, on which the following inscription is placed in gold letters "STATE PATROLMAN." He is also supplied with a number, which he wears on his arm, and a red flag, which he places in the ground on the section on which he is working, so that if the inspector or resident engineer passes over the road he knows that the patrolman is on the work that day, and that he is near to the point where the flag is planted.

The section covered by the patrolman ranges from four to eight miles in length, this distance varying with the density and character of the traffic on the road. Near the densely populated districts, where the travel is exceedingly heavy, a patrolman cannot properly take care of more than four miles, whereas, in outlying and less thickly settled portions, he can keep in first class condition from seven to eight miles of road. Stone chips and oil, asphalt, tar, or other patching material are placed at convenient intervals along the highways, and the patrolman is furnished with a wheelbarrow, with which he can carry this material to any point where a break may have occurred in the surface. It is the duty of the patrolman to go over his section of road at least once or twice a week, according to the location of the road, its traffic and its condition. He is also required, after every heavy storm, to clean out any ditches or culverts which may have become clogged, to repair any breaks that may occur in the surface, to cut down the weeds along the banks, and to keep the shoulders smooth and in

good condition. It is his duty to make all necessary repairs to the road just as soon as he notices the slightest wear or raveling, as it has been found that if this work is done at the first sign of wear, it is only necessary that the patrolman paint the spot with a little bituminous material, cover it with the stone chips and then compact it with a hand tamper. If the surface is neglected until a hole forms, then the patrolman cleans the cavity out thoroughly, paints the sides with bituminous material, fills in stone of the proper size, tamps it down, paints over the top of the new stone with the bituminous material, applies the chips and again tamps the surface.

There is persistently impressed upon the patrolman in Maryland the necessity of immediate repairs of the worn surface of the roadway, but a great deal depends upon the man and it is often a difficult matter to teach them to understand and to know exactly when and how to make the bituminous patches.

To assist the resident engineers of the commission in keeping a close watch over their patrolmen, an expert Maintenance Engineer has been developed, whose duty it is to go constantly over the roads, making reports as to the conditions found on each patrolman's section. This engineer is also required to report upon the physical and mental characteristics of each patrolman, and on the condition of his road and his tools. He also reports on the quantity of oil, stone chips and bituminous material he has on hand along the road, and on how he has handled his work, his methods, etc. The efficiency of each patrolman, as well as the character of his work, can readily be determined by this method, which also has the advantage of placing the office of the commission in possession of all the facts relating to the roads and to the results that have been accomplished on each section.

### EXPERIMENT WITH THE GANG SYSTEM

In 1914 the gang system was established experimentally on several of the heavily traveled roads after they had been completed. These gangs replaced the patrolmen in a number of instances, but it was found that the period of time required for the gang to pass from one end to the other of the section placed under it (thirty-five to forty miles) was so great that the repairs accumulating during this interval were more extensive than those which occurred under the plain patrol system. These gangs consisted of six or seven men and a foreman. They were equipped with the necessary steam rollers, wagons, and teams, tools, materials, etc. This method cost less than the patrol system, but the general upkeep and the condition of the roads was not so good. The method was abandoned, therefore, as the commission decided that it could not be recommended except under particularly favorable conditions.

On a number of roads it was then decided to try out the combination gang and patrol system, which was done during the same year. It developed that under this system the patrolmen could be given a large number of miles to take care of after the gang had passed over the roads in the spring, and had placed the surface and the shoulders in first class condition. The patrolman could then maintain this increased mileage in good condition until the gang passed over it again in the fall, at which time all heavy work, which the patrolman is not able to do, and which he does not have the proper equipment to do, was done. On the heavily traveled roads this combination has been found to give more satisfactory and more economical results than have been secured from the patrol system alone. It is agreed, however, that it is impossible to set down any hard and fast rule as to which of these systems should be used. Where the traffic is moderately heavy, the patrol system is undoubtedly the better method of maintenance, and where it is exceedingly light, the combination gang and patrol system will work well by having the gang pass over the roads early in the spring, removing any slides which have come down from the banks, cleaning off the roadway surface and placing it in good condition until the gang returns in the fall to repair the road for going through the winter.

The type of construction, the intensity of traffic, the topography of the country and the character of the soil all have a direct bearing as to which system of maintenance is the best for any particular road. All these conditions should be studied carefully before determining the method of operation and the system of maintenance that is to be adopted.

The following table shows the operation of the patrolmen by years:

| Year | Number of patrolmen | Miles maintained | Average number of miles maintained per patrolman |
|---|---|---|---|
| 1910 | 2 | | |
| 1911 | 55 | 305 | 5.50 |
| 1912 | 75 | 374 | 4.98 |
| 1913 | 107 | 575 | 5.37 |
| 1914 | 118 | 650 | 5.50 |
| 1915 | 101 | 600 | 5.94 |
| Average | 76 | 501 | 5.46 |

In addition to the number of patrolmen as shown in the preceding table, there were also employed from time to time, as needed for extraordinary repairs, 150 helpers for the patrolmen in 1912, 345 in 1913, 350 in 1914, and 225 in 1915.

The following table shows the maintenance costs for patrol service throughout the State, for oiling, for repair work, etc., in addition to the costs for regular oiling, spreading of stone chips, etc., in detail by years.

TABLE NO. 2.

COSTS FOR MAINTENANCE BY PATROL SYSTEM.

| Year | No. of miles maintained | Total cost | Average cost per mile | Patrolmen, helpers, teams, etc. | Gallons of oil for repair work | Cost of oil | Tons of stone chips and grit for repair work | Cost | Bridge repairs | Maintenance on turnpikes | Traveling repair gangs | Repair gangs and patrolmen's tools, etc. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1912 | 374 | $ 63,358.99 | $169.40 | $34,947.96 | 39,562 | $ 2,999.41 | 3,946 | $ 4,970.71 | $4,637.57 | $2,957.16 | $12,099.09 | 747.09 |
| 1913 | 575 | 136,530.81 | 237.44 | 70,150.66 | 118,574 | 9,820.48 | 12,669 | 17,767.03 | 3,228.36 | 5,128.47 | 15,520.76 | 1,024.10 |
| 1914 | 832 | 156,844.10 | 188.51 | 85,468.26 | 189,674 | 16,116.03 | 21,185 | 24,702.66 | 6,395.45 | 6,731.27 | 13,926.86 | 3,503.57 |
| 1915 | 1,049 | 208,055.91 | 198.37 | 67,783.19 | 225,989 | 17,694.12 | 30,176 | 35,388.93 | 9,240.72 | 4,227.35 | 22,185.19 | 1,536.41 |
| Total | 2,830 | $564,783.81 | $199.57 | $258,350.07 | 573,799 | $46,630.04 | 67,976 | $82,829.33 | $23,502.10 | $19,044.25 | $63,731.90 | 6,811.17 |

Macadam maintenance costs in Maryland have not been as high as many have believed, as will be seen from the following table. The State has been constructing a large mileage of roads of the concrete type, and on these the maintenance charges have been very low. It must be taken into consideration the traffic during the summer months on nearly all of the roads in the State system is heavy, and consists principally of hauling farm and garden products to the canneries and the markets from the farms, motor trucks and steel tired vehicles being used, the hauling of the canned products to the railroads and ports, and a notably heavy automobile traffic.

The average maintenance costs per mile have been as follows:

| | |
|---|---|
| 1910 and 1911 | $279.00 |
| 1912 | 340.00 |
| 1913 | 430.00 |
| 1914 | 372.00 |
| 1915 | 359.00 |

The average maintenance costs per mile, therefore, for the above period of six years have been but $356, most of the roads being fourteen and sixteen feet in width. It must also be taken into consideration that the above costs are not for roadway surface alone, but that they include cutting down weeds, removing slides, keeping the shoulders in shape, cleaning ditches and culverts and surface treating annually the roadway surface. This applies to all State roads in the system, as well as to a considerable mileage of State-Aid roads that have been taken over after construction, but not formally included in the list of State constructed roads. The State has built over 900 miles of road to January, 1916.

### MAINTENANCE RECEIPTS AND EXPENDITURES

The amount of money that has been available for maintenance has not, up to the present time, been sufficient to maintain the roads that the State has constructed, and for this reason there has been, each year, a deficit in the maintenance fund. This deficit has been accumulating for several years, as the roads have been given the maintenance, and the funds have been taken from other resources of the Roads Commission.

(*Continued on page* 49)

# Drainage and Foundation Problems Due to Soil and Other Geological Conditions

NOTWITHSTANDING the numerous discussions on the subject of Foundation and Drainage that appear in engineering periodicals, textbooks or in any pamphlets or work relating to highway work, there is no risk that too much care will be given to this most important subject.

For three reasons, this particular portion of the construction of a highway (or in fact of any engineering structure) can be especially considered as the most important and vital of the component parts of the finished project. These three reasons are:

First, that the permanent utility, safety, and appearance of a structure depend primarily on the foundation and drainage thereof.

Second, that the foundation and drainage of the road is a portion of that small part of the cost of highway construction, which can be considered as permanent, provided, of course, the work is properly and scientifically designed and carried to completion.

Third, because this particular part of the work is often hidden from sight and cannot, in its entirety, be examined to see whether the system is working in a proper manner.

Carelessness in construction of drainage and foundation is always attended with serious results and damage that cannot be easily or cheaply rectified. The trouble invariably occurs at a time when remedies are not easily applied as a result of heavy storms or severe weather conditions. Consequently no care should be lacking in the preliminary steps.

It may be said, without possibility of contradiction, that no reduction in the quality of foundation is possible, even with the most expensive and permanent type of road surface. In fact, the better the road surface, the more thorough and complete should be the investigation and determination of foundation conditions because the damage on account of foundation troubles would be far greater than in the case of cheaper road surfaces.

Our subject can be divided under two general heads:

First, the relation of subsurface water to the foundation and drainage of the road; with regard to the removal of water from the base of the road itself and also the prevention of subsurface water from surrounding areas penetrating the foundation and causing trouble with the stability of the structure, and

Second, the relation of surface water to the foundation and drainage of the road with regard to the disposition of surface water from the top of the road as well as the proper care of surface water from other sources, such as streams, water-courses, etc. A discussion of the latter item will probably include a consideration of the structures which are a part of the surface drainage system, as well as the method of securing proper foundations for such structures.

In consideration of the first section; that is, the sub-surface drainage of the road itself with regard to foundation. A properly designed road serves two purposes: First, as the track or means of carrying travel with safety and speed, and second, as a means of transferring the weight of moving loads to the subfoundation so as to properly distribute these loads over such an area that the earth subgrade of the road will properly support them. Neglecting types of road surface, this immediately makes it necessary for us to determine what is the best type of earth subgrade to be used as a road foundation. The answer to this question lies in the statement that any class of soil will provide a good foundation for the road structure, if kept dry. Consequently we develop the theorem that in order to construct a satisfactory road with proper foundation, it is necessary to provide adequate and suitable subgrade drainage in order that the road may stand and serve.

In order to keep the subgrade of the road dry, by providing proper drainage, different methods of procedure must be employed in order to secure the same results under diverse conditions. With soils of different porosity, it is merely necessary to provide frequent outlets for the subsurface water in order to lower the level of the ground water plane. In cases where impervious soils exist, the providing of outlets will not alone be sufficient to properly drain the foundation, hence different methods must be employed, commencing with the use of cross subdrains placed at frequent intervals and extending in extreme cases to the removal of a large amount of the subsoil and substituting for it sufficient suitably porous material properly drained to provide what is required for foundation.

In this connection, the following facts must be clearly emphasized; that no matter how porous the material in the road or in the foundation of the road, such porosity will be of little value if water may remain in the voids. In other words, all porous material in foundations should be provided with proper outlets to allow water to run out of the foundation to some convenient water course. At the same time, the material should be so confined as to form a firm and unyielding foundation to support the road.

In designing the foundation for a road, therefore, it is evident that a careful study should be made of the character of the soil beneath the road with the view to determining how it may best be drained so as to become a suitable foundation for the structure to be placed thereon.

The study of the soil conditions should be made in advance of the construction of the road and should be as exhaustive of sources of information as possible.

In the investigation of subsurface conditions, there is no time when better investigation can be made than in the spring of the year. The frost is out of the ground and the soft and boggy places in the road show up. If circumstances prohibit an investigation of the highway during this season, discussion should be had with residents along the road or with those town officials who have had supervision over the roads in the past.

It would be well to bear in mind that there are very few instances where money spent on foundation work is wasted. It is practically true that no road has yet been built which has been entirely successful in the design of its subsurface drainage, and the success of the road itself, as stated above, depends upon its foundation.

It will be interesting, in this particular connection, to call attention to a piece of highway constructed in Connecticut on what is known as "Branford Hill," where a heavy cut varying from six (6) to twelve (12) feet was made through a clay soil consisting of what is known in our country as "lamented" clay, that is clay deposited in layers of practically uniform thickness separated by fine sand joints. The material in this particular cut was so hard in dry weather that it was difficult for men to remove it with picks and it resisted the action of a steam shovel materially. During heavy summer rains, the material became saturated and muddy and the road leading to the steam shovel was corduroyed with old ties. Under the action of the heavily loaded clay wagons, these ties were forced into the wet clay subsoil for a depth of two (2) to three (3) feet. It was evident, therefore, that some radical and finished means of providing subsurface drainage was necessary to prevent any breaking up of the road surface under these abnormal conditions and the following method was employed:

Two side ditches were excavated at the foot of slopes in the cut to a depth of three (3) feet below the finished road grade. On the down hill side, a six (6) inch tile was placed in the bottom of this ditch, and on the up-hill side, a tile sufficient to take, not only the subsurface water but also the surface water which fell on the surrounding country and which was led down the slopes into frequent catch basins. The trenches about and above these tile were filled with broken stone and cross drains laid herringbone fashion were installed beneath the road surface at approximately fifty (50) foot intervals. On top of this drainage system was constructed a six (6) inch concrete road, which was practically impervious to water. With this radical and expensive treatment, we have had absolutely no trouble from subsurface water.

Lecture in Graduate Course in Highway Engineering, Columbia University March 6, 1916, by Charles J. Bennett, Highway Commissioner, State of Connecticut.

This was a condition that was discovered after the road was designed and contracted for and necessitated a radical change in the original design and a material change in the contract.

The following is a description of several types of foundation to be used in the construction of roads, having in mind the combination of subsurface drainage with proper supporting medium to carry the load from the road to the earth. These different methods of foundation construction are available in different cases. The determination of the type to be used depends upon the class of local material to be secured and to a great extent on the character of the subsurface material.

First: Rough stone base, which constitutes a depth of from twelve (12) to eighteen (18) inches of rough stone laid on the subgrade of the road with frequent outlets to water courses and without great regard to the uniformity of the sizes of the stone themselves or the character of the material making up the stone. This method should be used in the building of roads through clayey material, which is liable to become saturated and flow, and should be extended beyond the edge of the road surface proper.

Second: Telford base, consisting of the laying of uniform sized stone with the heavy side down in courses lateral to the axis of the road to a uniform depth and again with proper and frequent outlets for subsurface drainage to the side. The telford base is a suitable foundation to be used under heavy traveled roads where most of the load is to be carried by the telford base itself and where the surface of the road is of a light character and pervious to water.

This method is successful with almost any type of subsoil or in case of extreme trouble, may be combined with the use of a side drain.

Third: Gravel or stone fill; made with cobblestones or gravel from available sources of supply in the vicinity. This method is to be used where small stone or gravel is available for base fill and the soil is of a more or less doubtful character, and where a watertight and heavy surface is to be placed on the road, such as concrete or a heavy bituminous macadam. Again this stone or gravel fill should be supplied with frequent outlets to water-courses.

In connection with the installation of subsurface drainage, there are one or two other items which should be discussed. First, in the use of tile drain beneath the surface of the road itself; there is great danger of breaking or crushing of the tile by the passage of rollers or other heavy equipment over the top of the road even if the tile are placed at considerable depth. This difficulty is not true in the case of crushed stone drains. Here there is a certain danger of clogging up the drain with mud from exterior sources. If crushed stone drains are used, therefore, a suitable waterway should be provided at the bottom, possibly either a piece of plank or a rough stone drain made with flat stones for the sides and top. If tile are used, it is best to use bell and spigot pipe, so called, as these retain their alignment and grade far better than tile with open joints and there is not so much danger of clogging as with the ordinary land tile. Trouble sometimes occurs with tile drains on account of the fact that roots of trees enter the pipe in search of water and eventually clog the pipe for its entire area. In several instances, sewer drainage systems have been put entirely out of commission in this manner, roots forming a firm and almost solid mass within the pipe of the consistency of baled hay, making it necessary to entirely remove the tile. No matter how small the orifice, one small root will enter and expand. There is no remedy or safeguard against such trouble so far as is known.

As an illustration of the necessity of providing proper foundation drainage, one or two instances of trouble which arose from poor subsurface construction may be of interest. In one particular instance, a macadam road built on a clay foundation with approximately seven (7) inches of crushed stone broke up under the frost action and became an impassable quagmire. The road was a city street and the only means of carrying travel over the same during the rainy season in the spring was by the planking of a sufficient width to carry travel, laying stringers on top, allowing the weight of the plank and traffic to push the stringers into the clay beneath.

On the Mohawk division of the New York Central Railroad, an instance of extremely bad surface conditions was shown by the raising of the track in the spring for a distance of almost one-thousand feet (1,000 feet) to a height of from one (1) foot to eighteen (18) inches and the trembling and the breaking of the ground beneath tracks, showing that it was saturated with water.

Another instance of difficult highway construction was where a new location of the road passed through a swamp where it was necessary to remove the boggy material to about four (4) feet, filling the excavation with a large amount of stone from walls in the vicinity until a firm foundation for the road was secured. In this instance the ground on either side of the road pushed up to quite a considerable amount.

Following is the discussion of the second division of the subject, namely, the disposition of surface water with relation to the road:

First, with regard to the surface drainage from the road itself, and

Second, from other sources.

In order to properly safeguard a road from washouts, a proper system of surface drainage must be applied to carry the water from the surface of the road itself. This can be done by the installation of adequate side ditches and gutters along the road and frequent outlets through culverts to local watercourses to get the water away from the road as quickly as possible. These ditches and culverts should be provided with catch basins and inlets and all ditches and culverts should be sufficiently large to carry any possible amount of water which they will be required to take.

A peculiar instance of a very serious problem in the drainage of the surface as well as the subsurface of a road, was in the case of a highway constructed recently up a very steep hill in the town of Salisbury. The previous road was practically only wide enough to accommodate one vehicle and had constituted itself a drainage canal for the surrounding country. After every rain, the road surface was entirely washed out and the construction of a road in this vicinity was approached with some misgivings. It was decided that no matter how much it might cost the drainage must be properly taken care of, and therefore, a combination of two systems of disposing of the surface water was devised. First, the road surface itself was built on top of a stone fill about four (4) feet in depth at the bottom of which an open box culvert was installed to carry whatever water might enter beneath the road from the sides. The stone fill was extended to the extreme width of the road itself, that is, from shoulder to shoulder, and extremely deep and wide ditches were provided at the side of this road to accommodate the water that came from the road surface and from other sources.

The rubble drain was apparently separated from the base of the rock fill by a rise in the subgrade. Leak-offs were made from this fill into the rubble drain though in many instances the rubble drain followed the center of the road, but the intention was to provide not only surface and subgrade drainage from the road itself, but to keep off the surface drainage from the slopes.

While it may be alleged that too much money was spent on the drainage and foundation of this road for the purpose of caring for surface water, the fact remains that no trouble has occurred since the road was built and the drainage system is successful, even if a trifle expensive.

It is interesting to note also that no attempt was made to cut the top of the hill, but the entire slope was filled with stone as noted.

In consideration of disposal of surface water from other sources, great care should be taken to see that the water from other sources is kept away from the road as much as possible and when it must be brought near the road it should be led through it with culverts and bridges in such a manner as to prevent damage to the road surface, either in cuts or fills. In the case of heavy rains, ditches should be dug at the top of the slope with properly constructed sluices or flumes down the slopes to the ditches with baffles, so that the water will not damage the road structure. Flumes built down the slopes must be carefully constructed so that water will not wash beneath them and carry away earth onto the road itself.

Again where the water must be led down the sides of fills, when these fills are newly built, plank gutters or flumes should

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# New Specifications for Portland Cement

By George D. Steele

At the annual meeting of the American Society for Testing Materials, held at Atlantic City, New Jersey, the last week in June, the real power and importance of this strong technical society was clearly demonstrated in many ways. It was, from every viewpoint the most important meeting that has ever been held by the Society, and was the best attended in its history. Specifications were given particular attention, as the prominent technical men identified with the Society have realized for some years that the specifications covering numerous materials have not been kept up to the advancement that has been made in tests of materials, construction demands, etc. As had been anticipated by many of those familiar with the work of Committee C-1 on Cement, the existing standard specifications for cement were, by vote of the members present, replaced by the radically new ones which were presented to the Society during the meeting. Inasmuch as these specifications have already been adopted by the American Society for Testing Materials, there is no doubt whatever that they will be formally adopted by letter ballot of the total membership, as required by the rules of the Society. Also, in view of the fact that a representative of the American Society of Civil Engineers, the largest civil engineering society in the United States, and a representative of the United States Government Departmental Cement Committee assisted in the preparation of the new specifications, there is little doubt also that the new specification will, by the time they go into effect, have been adopted as the standard specifications of the American Society of Civil Engineers, and by all engineering departments and divisions of the United States Government.

A history of the specifications for Portland cement will be of interest, as it is not generally known, and will be given briefly herewith.

The first standard specification for Portland cement was adopted by the American Society for Testing Materials in 1904, and soon received extended recognition as a laudable attempt to standardize what had, up to that time, been variable practice. In a few years, however, to be exact, the constantly changing views on concrete and on cement led to a number of complaints, mainly by engineers, as to the requirements of the specifications, and repeated efforts were made to get the Committee to revise the standards. A certain conservatism, inspired by a desire for a reasonable permanence in standards, even at the expense of minor errors, managed to prevent any change in the specifications until 1908, and then again in 1909, when some changes, the principal of which were in the tensile requirements, were made.

But in 1912, the United States Government, by executive order, compelled all Federal Departments to adopt for use in all of the work coming under them, a Government Specification for Portland cement, which specification had been prepared by a special committee of Government engineers. This was a severe blow to the prestige of the standard specifications of the American Society for Testing Materials. But in March, 1912, the Socjety's cement committee recommended that a conference committee of the American Society of Civil Engineers, the Government Departmental Committee, and the Amerian Society for Testing Materials be organized for the purpose of conferring on and reconciling the differences in the specifications. This recommendation was accepted by all interested parties, and in pursuance thereof, there was organized in October, 1912, the Joint Conference on Uniform Methods of Test and Standard Specifications for Cement.

This conference reached practical agreement on the specifications in April, 1915, but its report, which was an extensive volume, was considered by the Cement Committee to be more elaborate than the instructions given the Conference, and the recommendations contained therein were not made public. They were, however, at the annual meeting at Atlantic City in 1915, made the subject of consideration of subcommittees for the ensuing year. And during the past year, the Conference and the Committee agreed upon a specification which was sent out for information to certain authorities some months ago, but which has never been made generally public. This specification, however, was further revised by the Committee, the Conference not being present, at a meeting at Atlantic City on June 28, last, and was submitted to the meeting of the Society on the following day.

There was little criticism on the floor at the meeting, but there was considerable debate and some spirited discussion regarding the title for the specification which had been submitted by the Committee. This title was as follows:

"American Specifications and Methods of Tests for Portland Cement." Commenting on this title, the report of the committee states "The Committee recommends that the proposed revised specifications for Portland cement be given the title 'American Specifications and Methods of Tests for Portland Cement.' In the judgment of the Committee, they are entitled to this distinction because they are the result of several years' work of the special committees of the Board of Direction of the American Society of Civil Engineers, the United States Government Departmental Committee, and Committee C-1. It is highly desirable to convey not only to those who use cement in this country, but also to our export trade, that there is a single uniform American specification for this important product."

This recommendation was referred to the Board of Direction of the American Society of Civil Engineers, which body returned it to be given full and due consideration at the Atlantic City meeting, accompanying it with the statement that in the opinion of the Board, such action would be invidious, owing to the fact that there are numerous other specifications of the Society to which the same arguments as to title could be applied. The discussion then resolved itself into two sides, one of which took the part of and argued for the "American" in the title, because of the impressive effect upon South American trade, and as a recognition of the three interests involved in the working up of the specifications.

The opposing side upheld the attitude of the Board of Direction of the American Society of Civil Engineers, and also disputed the right of anybody to usurp the word "American." The opposition to the use of the word "American" finally won out after considerable discussion and argument, and the title has been referred to the Board of Direction.

The personnel of the Committee, (C-1), has been changed. George F. Swain, Chairman; George S. Webster, Vice-Chairman, and Richard L. Humphrey, Secretary, have all resigned. Russel S. Greenman, of the New York State Engineer's office, has been elected Chairman; H. B. McFarland, Testing Engineer of the Atchison, Topeka & Santa Fe Railway, is Vice-Chairman, and P. H. Bates, of the United States Bureau of Standards is the new Secretary.

The following excellent editorial on these new specifications and the events leading up to their adoption appeared in a recent issue of *Engineering News*, the leading civil engineering publication of this country.

"The adoption by the annual meeting of the American Society for Testing Materials of the revised cement specification submitted by its committee on cement is a definite step forward toward that most desirable end—a nationally accepted cement standard. If, as seems probable, the last minute revisions are accepted by the United States Government and by the American Society of Civil Engineers, this specification will in fact, at least, warrant the name 'American' quite rightly denied it in the title by the meeting.

"Ten years ago the labeling of the universal acceptance of a cement specification as an important forward step would have sounded anachronistic, for following the promulgation of the 1904 standard specification, the purchase of cement throughout the country was gradually being brought under the provisions of that standard. Individual or freaky specifications were growing rarer and rarer, and hope was held out that in a year or two only a small percentage of the cement sold would have to answer other than the tests laid down by the American Society for Testing Materials.

But the knowledge of cement is in a state of flux. Old as are the fundamentals of this knowledge, the wonderful increase of concrete has necessarily multiplied investigation and

(*Continued on page 53*)

# The Ohio State Highway Department

## Work of the Bureau of Maintenance and Repair

By George D. Steele

*(Continued from July)*

IN the July issue of BETTER ROADS AND STREETS the author took up the general work of the Ohio State Highway Department, the work of the Bureau of Bridges and the Bureau of Construction. In this article, only the work of the Bureau of Maintenance and Repair, which is under the direction of A. H. Hinkle, Deputy Commissioner, will be taken up. There has been some good maintenance work done in Ohio, a considerable portion of which was gone over by the writer this past spring, and the material from which the matter contained in this article, unless otherwise stated, covers only the period from November 16, 1914, to December 31, 1915.



A. H. HINKLE
Deputy Bureau Maintenance and Repair

Ohio has been building her Main Market and Inter-County Highways very rapidly during the past few years. In fact, they have been built with the object of completing the largest possible mileage in the shortest possible time. In many respects, therefore, has their maintenance either been overlooked, or it has not been sufficient. This has, it is only just to say, been due to the lack of maintenance funds rather than to wilful neglect or to incompetency in the Maintenance Bureau. The Highway Department has the organization to properly and economically maintain the roads when they are once completed if the Department is only provided with the money that should be put into this all-important part of the work of developing a modern and well constructed highway system.

### ORGANIZATION OF THE BUREAU OF MAINTENANCE

The organization of the Bureau of Maintenance and Repair consists of one deputy, one assistant engineer, one draftsman, and one stenographer, all of whom have devoted their entire time to maintenance and repair work. The eight division engineers, the duties of whom were described in the July issue, and who supervise the work of the Bureau of Construction, have general supervision of the maintenance and repair work in the field. The division engineers report direct to the Deputy Commissioner in charge of Maintenance and Repair. The one engineer who is assistant to the Deputy takes their place and assists them so far as possible when they are too busy with construction work to look after the maintenance and repair work. Under these division engineers there are such superintendents, foremen, patrolmen, and inspectors as the field work demands.

### EXTENT OF REPAIR AND MAINTENANCE DURING 1915

The maintenance and repair work is growing by leaps and bounds as it naturally should, with the rapid increase in mileage of roads under the control of the State. It is not only growing in amount, but also in importance, owing to the greatly increased traffic from year to year on the public highways of the State. While a study of the relative importance of wagon roads as compared with railroads easily showed the railroads to be the more important a few years ago, it would now seem that a study of this same question will show that many of the main wagon roads of Ohio are, relatively speaking, as important, if not really more so, as many of the smaller railroads of the State. And this is responsible for the increased importance of the maintenance and repair work on the highways of the State from year to year. Road officials having charge of this work realize this great importance when they close a road for resurfacing or rebuilding, and observe the complaint and criticism made by the public because of the closing of the road to traffic.

The Bureau of Maintenance and Repair has made every reasonable effort during the past year to care for the roads under its charge as carefully as could be done, and yet be consistent with economy. When taking into consideration the great number of new employees which the increased work necessarily brought about, and the fact that much of the work is now done on scattered and disconnected short sections of the State highways, it should follow that the work can be more economically done in future years with a greater mileage of roads in longer sections to maintain. Naturally, too, with better experienced and more trained men, as the organization grows older, much more efficient work should be accomplished. This latter statement is impressed upon those who are in a position to observe the blunders and mistakes frequently made by inexperienced assistants.

The following set of tables will show some facts concerning the maintenance and repair work on the roads under the jurisdiction of the Bureau of Maintenance and Repair in Ohio for the period from November 16, 1914, to December 31, 1915. The figures are all official, having been taken from the records of the Department.

MILEAGE AND AMOUNT EXPENDED FOR MAINTENANCE AND REPAIR

| Classification | Maintenance and Repair Proper, All Types | Reconstructed All Types |
|---|---|---|
| Miles | 584.58 | 136.91 |
| Roadbed | $47,746.42 | $107,592.95 |
| Surface | 128,630.59 | 463,468.20 |
| Bridges & culverts | 1,858.52 | 14,017.34 |
| Superintendence | 16,137.09 | 25,302.11 |
| Total | $194,372.62 | $610,380.60 |

The average amount paid per mile of road for maintenance and repair, proper, on all types of roads for the surface only, was $168, and the total amount paid for maintenance and repair per mile of road, including all charges, was $254.

The average amount paid per mile of road for reconstruction of the surface only was $3,385, and the total amount paid per mile for reconstruction, including all charges, was $4,459.

The following table shows the amounts paid for maintenance and repair and for reconstruction of the different types of roads, according to type, with the distribution of these amounts as to roadbed, surface, etc.

| Type of Road | Maintenance and Repair Proper | Reconstruction |
|---|---|---|
| Macadam | $135,409.06 | $456,127.39 |
| Concrete | 17,502.18 | 13,844.96 |
| Brick | 30,562.52 | 107,237.04 |
| Gravel | 10,880.86 | 8,344.88 |
| Wood block | | 23,980.57 |
| Miscellaneous— | | |
| Bridges and Culverts | 855.76 | |
| Earth | 18.00 | |

There were no expenditures on 57.77 miles of brick roads, 20.26 miles of concrete, 104.09 miles of macadam, and 1.45 miles of gravel roads that were completed on or before July 1, 1915.

A total of 113.81 miles of roads was given surface treatment, the cost of which was $58,201.24, or at the average cost of $511 per mile.

The detailed expenditures for maintenance and repair and for reconstruction of the various types of roads by type were as follows:

MACADAM ROADS

| Classification of Amount Paid | Maintenance and Repair 302.95 miles | Reconstruction 121.49 miles |
|---|---|---|
| Roadbed | $ 14,396.60 | $ 92,397.14 |
| Surface | 110,970.85 | 331,188.79 |
| Bridges & culverts | 1,130.31 | 11,784.21 |
| Superintendence | 8,911.30 | 20,757.25 |
| Total | $135,409.06 | $456,127.39 |

The average amount paid per mile for maintenance and repair on the surface of macadam roads was $273, and the total amount per mile for the entire roadway was $333, which in-

cluded all the items shown above. The average amount per mile for the reconstruction of the surface only was $2,726, and for the entire roadway was $3,754.

CONCRETE ROADS

| Classification of Amount Paid | Maintenance and Repair 107.11 miles | Reconstruction 0.74 miles |
|---|---|---|
| Roadbed | $11,891.67 | $ 1,996.65 |
| Surface | 3,639.25 | 11,326.35 |
| Bridges & culverts | 169.65 | 000.00 |
| Superintendence | 1,801.61 | 521.96 |
| Total | $17,502.18 | $13,844.96 |

The average amount paid per mile for maintenance and repair on the surface of concrete roads was $29, and the total amount per mile for the entire roadway was $137, which included all the items shown above. The average amount per mile for the reconstruction of the surface only was $15,306, and for the entire roadway was $18,709. These high averages are due to the fact that the reconstruction amounted to but 0.74 of a mile.

BRICK ROADS

| Classification of Amount Paid | Maintenance and Repair 145.13 miles | Reconstruction 7.56 miles |
|---|---|---|
| Roadbed | $20,141.85 | $ 9,853.33 |
| Surface | 5,857.95 | 94,503.58 |
| Bridges & culverts | 528.46 | 106.38 |
| Superintendence | 4,034.26 | 2,763.75 |
| Total | $30,562.52 | $107,237.04 |

The average amount paid per mile for maintenance and repair to the surface of the brick road was $29, and the total amount per mile for the entire roadway was $151, which included all the items shown above. The average amount per mile for the reconstruction of the surface only was $12,500, and for the entire roadway the average was $14,183 per mile.

GRAVEL ROADS

| Classification of Amount Paid | Maintenance and Repair 27.66 miles | Reconstruction 6.74 miles |
|---|---|---|
| Roadbed | $1,316.30 | $2,704.59 |
| Surface | 8,144.54 | 4,630.37 |
| Bridges & culverts | 30.10 | 264.14 |
| Superintendence | 1,389.92 | 745.78 |
| Total | $10,880.86 | $8,344.88 |

The average amount paid per mile for maintenance and repair to the surface of gravel roads was $280, and the total amount per mile for the entire roadway was $374, which included all the items shown above. The average amount per mile for the reconstruction of the surface only was $687, and for the entire roadway the average amount was $1,238 per mile.

There was 0.38 of a mile of wood block reconstructed, for which there was expended $641.24 on the roadbed, $21,819.11 on the surface, $1,128.65 on the bridges and culverts, $391.57 for superintendence, making a total of $23,980.57. This was at the average of $57,419 per mile for the surface only, or $63,107 per mile for the entire roadway.

On earth roads, but 1.73 miles were placed under maintenance and repair, and for which $18 was expended on the surface, or at the rate of $10.40 per mile.

From the foregoing tables we find that actual work has been done on 721.49 miles of highway, and that for this work there was paid during this period the sum of $804,753.22. Of this total mileage, 136.53 miles consisted of rebuilding old roads, most of which were originally built by the counties, and which had received little or no repairs during their early life. They were, therefore, in nearly every case well worn out.

The total amount paid during the thirteen and one-half months covered by this article on the rebuilding of 136.53 miles of old road was $610,380.65, or an average of $4,459 per mile.

The total amount paid out during this same period of time for what might be called the maintenance and repair proper of 584.58 miles of road was $194,372.62. If to this latter mileage is added the 183.57 miles of State road which received no maintenance and repair work during this period, and which were completed previous to July 1, 1914, we get an average of $254 per mile paid for maintenance and repair during the thirteen and one half months referred to.

METHOD OF SUPERINTENDENTS KEEPING RECORDS, SUBMITTING REPORTS, ETC.

The method by which the field superintendent keeps his records, submits his reports to the office of the Bureau of Maintenance and Repair in Columbus, etc., so that the proper distribution of accounts can be made, is, the present administration rightly believes, very important. The system that is in use now has been worked out with a view of furnishing the required records to the office, and of having the desired checks upon the expenditure of funds, with a minimum of clerical work on the part of the superintendent, as well as upon the department office. The details of this system are clearly given in a booklet of instructions to the superintendents which was issued last spring.

The Bureau of Maintenance and Repair also plans to give further assistance to the men in the field by having printed a more or less detailed description of how to make the repairs and how to do the maintenance work on the various types of road. It is believed that this would aid somewhat in relieving the engineers from repeatedly making detailed explanations of how to make the various kinds of repairs. This is not to be done, however, under any assumption that the engineers' services can be dispensed with to any great degree, for it is well known that the best way to teach a new superintendent to do certain kinds of repair work is to demonstrate in his presence the method of making such repairs.

SOME PROBLEMS MET IN DOING THE REPAIR WORK

The maintenance and repair work presents many intricate problems, as well as furnishes an interesting and instructive study to those engaged in it, and who have an unprejudiced mind and are willing to learn.



**Harrison County—Dennison-Cadiz Inter-county Highway, No. 370, macadam improvement. One of the very first State aid improvements in Ohio, being resurfaced after seven years' wear.**

Perhaps in no branch of our institution of government is public work so subjected to the scrutiny and criticism of the average layman as is the maintaining and repairing of our public highways. This is due to various causes, among which may be mentioned as most prominent the following:

1. The frequent waste of public funds in former days, either because of the inexperience of the officials in road work or an indifference occasionally amounting to a weakness on their part to such an extent as to cause them to yield to the undue pressure of certain material interests.

2. To the fact that the work is of such a nature that it readily presents itself to the gaze of the public. This causes trouble from two sources: (1) The work looks easy to the average citizen and he feels free to criticize, although he may never have had any experience in road work, and he is certain criticism of the methods of a superintendent in charge of the work, and who have given years to the study and practice of this subject. (2) The very fact that the work is subjected to the gaze of almost every one and looks easy of accomplishment stimulates others to aspire for the position of the road patrolmen, forman, superintendent, or inspector, and this contributes largely to the frequent change of officials.

Public criticism has many good influences and should always be given due consideration. Yet there is a certain phase of it which may be evil, as pointed out above. Often has undue criticism of the methods of a superintendent in charge of the work been sufficient to influence him to be inclined to disobey the orders of his superior, thus causing considerable loss and trouble.

As an illustration of this, a superintendent of the Ohio department called the office of the department at Columbus one day by long distance phone and insisted that he be permitted to lay some wood block in a pavement at a different angle than that at which he was instructed to lay it, because some influential fellow had seen it laid at such an angle in former years and insisted that the method of the superintendent was wrong.



**Licking County—Newark-New Lexington Road, Inter-county Highway No. 356. Spreading screenings over oil surface.**

Public criticism is a factor that officials should recognize and give attention to. The misinformed can be correctly informed, the uninformed can be frequently enlightened by proper explanation, and the pernicious criticisms sometimes can be exposed. The most obstinate case to deal with is the "wiseacre" who is born, as he believes, with an instinct of road building, but in fact has no knowledge whatever of the subject, and is also incapable of learning.

There are two other conditions which the Maintenance and Repair Bureau must continually combat. This applies not only to Ohio, but to all other States. While there is a large part of the field employees who are readily instructed in proper



**Noble County—Removing Slide on the Caldwell-Marietta Inter-county Highway No. 391. Bank protected with timber retaining wall.**

methods of doing their work, there are two classes at opposite ends of the list that must have almost constant attention. The first of these is that class of persons who want to do the work as they have formerly done it, regardless of the fact that the methods they insist on using are no longer considered good practice. The second is that class of experimenters who want to experiment with every piece of work they undertake, notwithstanding the fact that the methods they propose have been found by long practice to be defective. While it is expected that every employee will obey his superior, yet in spite of this expectation, it is necessary, especially where many new employees are engaged each year, to continually guard against the waste of funds by these two classes of extremists.

A condition which has handicapped the maintenance and repair work in Ohio to some extent, and which will become a more serious problem in future years until some legislative relief is provided, is the fact that there is not any legal method prescribed for the disposal of broken and worn out tools and equipment. The superintendents in the field have been instructed to care for all broken and worn out tools until some method of disposing of them shall be provided. To require a superintendent to store or to carry with him such equipment is, of course, an expense which the State highway department should not be required to bear. But up to the present time it seems that no satisfactory method has been discovered under the present laws whereby such tools can be disposed of. It is hoped that some satisfactory means will be provided, at least within the next year or so, whereby a superintendent can free himself from the responsibility, and the department from the expense of this burden.

The purchasing by competitive bidding of the materials used in the force account work is quite a task, and, it would seem, is extensive enough to warrant one person giving most of his time and attention to this work. This same person could audit and approve all bills for such material, which would expedite the correct payment of such bills. If the engineers were relieved of much of the detail of this responsibility, they could devote to good advantage more attention to the work in the field, and thus be of greater aid in securing more efficient work. As the work of the Bureau is now handled, requistions for



**Clark County—National Road, showing result secured on a wide road surface.**

the materials are made out by the division engineers, or by the superintendents in the field and then approved by the division engineers, then bids are asked for on the materials that are wanted, detailed specifications being sent to all known prospective bidders, and an order is then placed with the lowest bidder. The requisitions, requests for bids, and the orders are each given a serial number, the requisition number being carried on the invitation, and both the requisition number and the invitation number carried on the order. All companies are requested to give the order number on all bills as they are rendered. This method to related numbering makes it possible to trace in a minimum amount of time the operations for any purchase. The superintendents in the field are permitted to purchase direct small articles necessary to prevent the work being delayed. All material is purchased with the freight prepaid, so far as is practicable.

In spite of all the criticism that has been made, and all the obstacles that have been met, the maintenance and repair work of the Bureau is becoming more and more in favor, and the that was accomplished last year far exceeds that of any previous year. Another encouraging feature is the fact that during the past couple of years, each year has seen a greater number of experienced men engaged in maintenance and repair work.

### NATURE OF REPAIRS AND FIELD OPERATIONS

The actual field operations would be interesting to take up at some length, but this would require too much space to be

published in detail in this article. The work will, therefore, be but briefly commented upon. The principal types of road surfaces will be taken up separately and an idea given as to the work that has been done and the methods employed.

### BRICK ROADS

Many miscellaneous repairs have been made during 1915 on the brick roads throughout the State. The greater portion of these repairs, as has been seen from the table showing the expenditures, has been made to the roadbed. The repairs that have been made to the surface of these brick roads have been largely required because of a defective foundation. The rolled gravel foundation has been most frequently at fault. While this type of foundation seems to be satisfactory in some places, even where the pavement has been down a number of years, yet in many other places it has failed badly. It has been generally noticed that a brick pavement laid on this kind of foundation is sometimes in good condition until a great amount of heavy truck hauling comes onto it, when it very often suddenly goes to pieces. Quite in contrast to this are many of the brick roads in Ohio that are laid on a concrete foundation. Many of these roads have had practically no repairs to the surface since they have been constructed. Cracks that have come in the brick roads in some places have been filled with tar and then covered with sand in the same manner that this work is done in the cracks that have come in the concrete roads, and the results from this method of repair have been very satisfactory. It would seem that trouble from any reasonable amount of cracking in the brick roadway can be eliminated at a very nominal cost by this method of repairing.

### CONCRETE ROADS

In the case of the concrete road, the greater item of repair again applies to the roadbed. The methods of repairing the surface consist largely in filling the joints and cracks with tar and then covering the newly poured tar with sand. After several years experience in the maintaining of concrete roads, it appears that the grade of tar that gives the best results for this work is the tar passing the Ohio State Highway Department specifications for bituminous material T-1. A heavier material than this will chip off during cold weather, while a lighter material will be inclined to melt and run out of the cracks during the hot days in summer. This filling of the cracks with tar is done at least once a year, and on roads where the traffic is heavy the cracks are filled twice a year. The experience of the Bureau of Maintenance has shown that it is well to touch up the surface of the concrete road by this method of treatment as frequently as necessary, as the cost of the treatment is not very great when the cracks are not very numerous, and the sooner the cracks are taken care of, the better it is for the pavement, and the lesser the maintenance charges later on.

Any small holes or depressions in the surface of the concrete pavement are also filled with tar and covered with sand, and maintained in the same manner as are the cracks of this type of pavement. Larger depressions and holes in the surface are filled by painting their surface with tar after they have been thoroughly cleaned out, and then building up the proper thickness by the use of clean crushed stone or gravel and binding with tar in about the same method as a tar macadam road is constructed by the penetration method. The size of the stone or gravel used is varied according to the depth of the depression or hole that is being repaired. When the area of the failure in the pavement is large enough to warrant it, the entire section of the pavement is removed and replaced with a newly constructed section.

### MACADAM ROADS

While the continued rains of the past season were a serious handicap, and greatly increased the cost of construction operations, as well as the application of bituminous surface treatments, they were of great benefit to the water-bound macadam roads of the State. In a few instances the resulting high water caused by heavy rains overflowed sections of road and washed the binder from the stone. When new screenings were spread over these sections before the surface had started to ravel, no difficulties were experienced in preserving the road. In general, however, the rains came at such intervals and in such amounts as to lay the dust and thus hold the binder in the road.

Many of the macadam roads built in accordance with the Ohio State Highway Department specifications with the large stone in the top course, tend to become quite rough when the harder limestones, which do not wear rapidly, have been used in the construction of the surface. This tendency is further exaggerated when the steel-tired traffic is proportionably small, and does not produce new dust by wearing down the coarse stone. As traveling over roads in this condition is unpleasant, they have been the cause of considerable unfavorable criticism against the highway department.

Roads subject to considerable steel traffic, combined with motor vehicles, have been treated with a light road oil which passes the department specifications for bituminous material C. O. This material is applied cold at the rate of from one-fifth to one-third of a gallon per square yard before the original binder has been swept from the road. A thin covering of sand has been used in some cases very satisfactorily to prevent the oil picking up and becoming unpleasant to the traffic using the road immediately following this application. The roads thus treated were in good condition some months after they had been so treated. They should receive a similar treatment every year until a satisfactory mat is secured. The cost of this work is from $150 to $325 per mile of road sixteen feet in width, according to the quantity of oil and covering material that is used.

Sections of road subject to considerable automobile traffic, and sections from which much of the surface binder has been blown have been treated with an application of one of the heavier asphalt oils or tars. These treatments are giving satisfactory service and have been very favorably commented upon by the traveling public using the roads.

The longest section of road thus treated is on the Columbus-Newark inter-county highway Number 47 in Licking County. This section, which is 13.41 miles in length, extending from the Summit station road, one mile east of the Franklin County line, to Granville, was used to demonstrate the merits of several of the different grades of bituminous materials. Similar experiments have been made at other places, but never on so large a scale, in connection with a road built of the comparatively soft limestone so common in Ohio.

This experiment of surface treatment is divided into six sections, the location of the various types of materials used being as follows:

*Section No.* 1. High Carbon Tar—H. T.—1. From the Summit road to a point about 200 feet east of the P. C. C. & St. L. railroad crossing.

*Section No.* 2. Low Carbon Tar—H. T.—2. From the east end of Section No. 1 to the old fair grounds near the West road to Pataskala.

*Section No.* 3. Asphalt Oil.—H. O. (Mexican). From the east end of Section No. 2 to a point one-quarter mile east of a road known locally as Crazy Lane.

*Section No.* 4. Asphalt Oil C. O. (Trinidad A.) From the east end of Section No. 3 to one-half mile west of the Outville road.

*Section No.* 5. Asphalt Oil H. O. (Aztec). From the east end of Section No. 4 to a culvert about one-half mile west of Goose Lane.

*Section No.* 6. Asphalt Oil H. O. (Illinois). From the east end of Section No. 5 to Granville.

The tar on this road was applied at the rate of one-half gallon per square yard, and the other bituminous materials were applied at the rate of about one-third of a gallon per square yard. A good quality of washed gravel of a size that would pass a screen having one-half inch round holes and be retained on a screen with three-sixteenth inch holes was used as a covering material. An excess of this material was used on Sections No. 4 and No. 5. Most of the excess screenings, which have been brushed from the road by traffic remain near the shoulders, and will be available for use next year. At the last inspection, the three sections on which the heavier materials were used were in the best condition. This result would be expected, as the lighter oils require several successive applications in order to obtain satisfactory results.

In most cases the grit or pebbles were unloaded and delivered along the road by a local superintendent before the arrival of the distributor and outfit. Three of these oiling outfits were operated by the highway department last year, and some interesting costs have been worked up. These will be

presented to the readers of Better Roads and Streets in an early issue. The cleaning of the surface of the road was done after the arrival of the oiling outfit, and under the general supervision of the superintendent who traveled with and was in charge of the outfit. The local superintendent then acted as his assistant, and directed the spreading of the covering material, following up the distributor. This arrangement proved very satisfactory last year, and is being continued this year on surface treatment work in all instances where the department distributors are being used. This year, however, some of this work has been let out on contract, the price for the bituminous material being applied on the road instead of f. o. b. cars at certain convenient points.

Patching the holes which develop in macadam roads is a process which requires considerable care and should always be under the direction of a man who is thoroughly experienced in this particular work. In general, these patches should be made of the same material as the original material of which the road was constructed. Therefore, when a road is being built, convenient small piles of the stone and screenings should be placed along the side of the roadway, but in such locations that they will not be disturbed by or be a menace to traffic. It is impossible, however, to prevent newly made water-bound macadam patches from being "plucked" and raveled by automobile traffic, so that really first-class patches of this type are very difficult to make and keep in good condition. Another thing that must be taken into consideration is the fact that a bituminous surface treatment will not stick to a new water-bound patch. Consequently, during the past year, a number of patches have been made on water-bound macadam roads previous to applying a bituminous surface treatment by tamping a cold mixture of cut-back asphalt and stone chips into the hole, which previously had been cleaned and painted with cut-back asphalt. Similar work has also been done with a mixture of stone chips and hot asphaltic oil passing the department specifications for bituminous material H. O. The results obtained appear to be generally satisfactory, but during the time that these patches have been under observation, it is considered too short to warrant any final conclusions.

### GRAVEL ROADS

The gravel road is a road that is easy to construct, and the methods of repairing it are generally simpler than the methods required in repairing most other types of roads. It is with this type of road perhaps more than with any other type, however, that constant maintenance is needed in order to keep the road in good condition throughout the year. While the surface is quite soft during certain seasons of the year, and may soon become somewhat out of shape, its surface also yields very readily to the process of being put back in good shape. For this reason, the regular and systematic dragging of the surface of the gravel road is imperative, and is the proper maintenance to be given the road. The little holes and ruts that will appear are kept filled with gravel either by the addition of a little new gravel, or by scraping some of the gravel displaced by traffic back into the holes or ruts by the use of the road drag. No large deposits of gravel should be permitted to be made on the surface, excepting during the construction of the new gravel road. The secret of the success in maintaining the gravel roads is the placing of small quantities of new gravel in the depressions, or in thin layers over the surface, or moving to the proper position small quantities of the new gravel that is already on the surface, and in doing this at a time when the surface of the road is saturated with water, and hence will most readily admit of the bonding of the new material to it.

### MISCELLANEOUS WORK

While the maintenance and repair work of the Ohio department has been quite heavy during the past year, and has kept the employees of the Bureau of Maintenance and Repair very busy, yet in addition to this work there has always been more or less miscellaneous work bearing on the subject of maintenance and repair which has had to be done. Some of these miscellaneous matters which were given attention during 1915 are the following:

1. The preparation of the first draft of a code of traffic rules and regulations in accordance with Section 7,246 of the General Code of Ohio. This book of traffic rules and regulations was issued in final form by the department last spring.

2. Considerable work has been done toward the preparation of a set of standards, which set of standards includes standard cross-sections for all of the various types and widths of pavement commonly built by the department, standards for tool houses and tool boxes, a standard set of symbols for use on profiles and maps, standards for guard rails, and the standards for some small tools, such as harrows, etc.

3. The anti-rutting campaign has been carried on to a limited degree during the year 1915, but on a larger and more pretentious scale than during 1914. Anti-rutting signs have been erected on a large number of sections of road, and a large placard prepared and placed on the roads. This placard calls attention to the serious destruction of the roads by vehicles driving in a single track. It is intended to encourage this year the display of this placard in livery stables, garages, automobile club rooms, and in other places where those most frequently using the roads meet, and where they will have their attention called to the financial waste of driving in a single track, thus destroying the road in a comparatively short time. Any type of road excepting of the highest pavement types will be materially benefited by having the traffic well distributed over its entire width.

4. Inasmuch as the Highway Act of the State of Ohio makes the highway department a sort of advisory board to township and county officials throughout the State, there come into the office a large number of inquiries, no small number of which are bearing on the subjects of maintenance and repair. Much time has been devoted to satisfactorily answering these inquiries, as well as many that are made by private citizens of the State, some of whom make it a point to call at the offices of the department and secure the desired information first handed. The technical magazines and the officials of other States frequently ask for information which it would seem discourteous not to give, and yet which takes considerable of the time of the small force of the Bureau of Maintenance and Repair.

The following table shows the repair work that was placed under contract from November 16, 1914, to December 31, 1915, and the amounts paid on each portion of the road that period.

REPAIR WORK DONE BY CONTRACT

| | |
|---|---|
| Total number of miles contracted for | 129.05 |
| Contract price | $647,959.78 |
| Amount paid for roadbed | $ 76,543.69 |
| Amount paid for surface | $348,918.81 |
| Amount paid for bridges and culverts | $ 6,534.17 |
| Amount paid for engineering and superintendence | $ 16,747.89 |
| Total amount paid on contracts | $448,744.56 |

The following table shows the repair work that was done by the Bureau of Maintenance and Repair from November 16, 1914, to December 31, 1915 by force account.

REPAIR WORK DONE BY FORCE ACCOUNT

| | |
|---|---|
| Total length in miles | 633.31 |
| Amount paid for roadbed | $ 78,795.68 |
| Amount paid for surface | $243,179.98 |
| Amount paid for bridges and culverts | $ 9,341.69 |
| Amount paid for engineering and superintendence | $ 24,691.31 |
| Total amount paid on force account work | $356,008.66 |

There was, therefore, the following total amount of work done under the supervision of the Bureau of Maintenance and Repair by contract and force account on repair work during the period from November 16, 1914, to December 31, 1915.

| Item | By Contract | By Force Account | Total |
|---|---|---|---|
| Total length in miles | 129.03 | 633.31 | 762.36 |
| Total contract price | $647,959.78 | | $647,959.78 |
| Total paid for roadbed | $ 76,543.69 | $ 78,795.68 | $155,339.37 |
| Total paid for surface | $348,918.81 | $243,179.98 | $592,098.79 |
| Total paid for bridges and culverts | $ 6,534.17 | $ 9,341.69 | $ 15,875.86 |
| Total paid for engineering & superintendence | $ 16,747.89 | $ 24,691.31 | $ 41,439.20 |
| Total amounts paid for repairs | $448,744.56 | $356,008.66 | $804,753.22 |

# Graduate Courses for Practicing Engineers

THE practicing engineer may secure advanced knowledge pertaining to modern practice in his specialty by utilization of one or more of the following agencies: (a) technical literature; (b) meetings and transactions of technical societies; (c) graduate engineering courses in technical institutions.

In technical periodicals may be found innumerable articles pertaining to any one of the several fields of engineering. This literature is distributed through many publications. For example, the Davis Library of Highway Engineering at Columbia University subscribes to eighty periodicals which contain articles on highway engineering or closely allied subjects. The experienced highway engineer finds in this immense amount of literature many articles of value. As a medium for the average engineer to secure a knowledge of fundamental principles and reliable information pertaining to modern highway engineering, technical literature, as found in both books and periodicals, proves unsatisfactory unless his reading is directed by an expert.

Men interested in engineering work will, in most cases, receive valuable inspiration and information from attendance at meetings and a perusal of the literature of engineering societies. The interchange of opinions and experiences connected with the many problems of engineering, which is accomplished through the medium of such conferences, is of inestimable value. As a source of training in fundamentals and the acquisition of comprehensive advanced knowledge in the several branches of engineering, it is not usually successful.

American educational institutions offer the following channels which are open to men who desire to equip themselves for the profession of engineering.

(1) A Bachelor of Arts, Bachelor of Philosophy, or Bachelor of Science collegiate course with electives in engineering.

(2) A four-year course in general engineering.

(3) A four-year course in a special field of engineering.

(4) A graduate engineering course requiring a baccalaureate degree and a total attendance in educational institutions of from five to six years.

(5) Graduate engineering courses after having followed out one of the educational lines outlined above.

By a judicious utilization of educational facilities, the acquisition of an educational training for any given branch of the engineering profession may be attained by several combinations of the courses previously mentioned. For example, it is evident that a man may pursue a four-year general engineering course devoting one-third time to the humanities, one third to pure science, and one-third to the fundamentals of engineering. A graduate in such a course, if he desires to fit himself to occupy technical positions of responsibility in a given field of engineering should, after a few years of practical experience, take advanced engineering courses especially designed for practicing engineers in his chosen specialty. The limits of this paper do not permit of a discussion of the relative advantages of all the methods of preparation for an engineering career.

As used in this paper, graduate courses for practicing engineers refer to advanced specialized courses designed primarily for men who have taken a first degree in art, science, or engineering, who have acquired a knowledge of fundamental principles upon which such advanced courses are based, and who have had a certain amount of practical experience in engineering work.

Based on an experience with graduate courses for practicing engineers extending over a period of five years, it has been found that the following classes of men are interested in such courses: (a) graduates of four-year Bachelor of Science courses in general engineering and graduates in non-technical courses who wish to equip themselves for a special field of engineering work; (b) graduates in civil, chemical, electrical, mechanical, and mining engineering courses who come in contact with problems or fields of work with reference to which they desire detailed information based on modern engineering experience; (c) non-graduates who may be engineers, chemists, contractors, manufacturers, or others interested in some special branch of engineering and who have acquired a sufficient knowledge of the fundamental principles to enable them to carry on advanced work satisfactorily. As a definite indication of the demand for advanced courses in special fields of engineering will be cited the fact that during the past five years there have been 229 registrations in the graduate courses in highway engineering at Columbia University.

The conclusion has been reached by experienced engineers that, if graduate courses are to satisfactorily meet the demands of the profession, the following conditions should be fulfilled:

First, the courses must be given by specialists who are acknowledged experts.

Second, the courses must be given under such conditions that it will be practicable for practicing engineers and others engaged in engineering work to take advantage of the opportunities offered.

Third, the graduate work must be broadly administered so that the courses of instruction are open to any mature man provided he can satisfy the prerequisites for the given course or courses which he desires to take.

Fourth, the content of the courses must cover detailed information pertaining to the most recent developments of modern practice.

Fifth, the methods of presentation of the subject matter of the course must be adaptable to the class of men enrolled.

Sixth, ample facilities must be available for conducting research work in laboratories, libraries, and in the field, where every phase of the special field of engineering covered by the graduate courses may be investigated.

As an example of a plan which has worked out satisfactorily in supplying the demand for graduate courses for practicing engineers, certain details and facts in connection with the graduate course in highway engineering at Columbia will be given. The objects in view in founding this course were to elevate the profession of highway engineering in America to the plane of the National Department of Roads and Bridges of France and to provide an opportunity for men engaged in highway work to obtain advanced instruction and training under favorable conditions. The heads of national, State, county, and municipal highway departments should be broadly educated, thoroughly trained and experienced specialists in highway engineering and efficient executives. They should be able to publicly discuss and economically solve the fundamental problems of economics, administration, construction, and maintenance. Such men should have a broad educational training in such humanities as English, history, economics, philosophy, political and social science. They should also be well grounded in the fundamentals of pure and applied science which underly highway engineering and the several branches of civil engineering which are utilized in highway work. After a man has secured his fundamental education in engineering and has had a certain amount of practical experience in highway work, the opportune time has arrived for securing professional equipment through the medium of graduate courses in highway engineering.

For many reasons it is fortunate that the first course of this character was established at a university presided over by a president and trustees who look upon the work of the university from an exceptionally liberal standpoint. While maintaining the high character of all degrees conferred, these men believe in opening the courses of instruction to any mature man provided he has the prerequisites for any given course and earnestly seeks information. Likewise it is fortunate that the administrative authorities allowed the introduction of an innovation as far as the period of attendance is concerned. The arrangement of the graduate work so that the several courses can be taken by engineers, chemists, highway officials, and others desirous of securing advanced instruction in highway engineering under favorable conditions has been fulfilled by, first, giving all graduate courses in the period when it is practicable to secure leave of absence, namely, from December 1 to April 1, and, second, by giving each course in a period of from two to three weeks duration. This latter arrangement enables men who are particularly interested in certain groups

Presented before the Society for the Promotion of Engineering Education at the University of Virginia Convention on June 20, 1916, by Arthur H. Blanchard, M. Am. Soc. C. E., Professor in Charge of the Graduate Course in Highway Engineering at Columbia University, and Consulting Highway Engineer, New York City.

of subjects or who are not able to be in attendance for the entire winter session to take any course or group of courses, the prerequisites for which they are able to present.

The following statement gives a comprehensive idea of the scope of the graduate course and the periods in which the several courses were given during the 1915-1916 session.

Highway Engineering 101—Economics and Design of Roads and Pavements. February 23 to March 8.

Highway Engineering 102—Broken Stone, Gravel, and Other Roads; Brick, Stone Block, Wood Block, and Cement-Concrete Pavements. February 9 to February 21.

Highway Engineering 103—Bituminous Surfaces and Bituminous Pavements. January 7 to January 25.

Highway Engineering 104—Highway Jurisprudence, Highway Laws and Systems of Administration. February 23 to March 8.

Highway Engineering 105—Highway Bridges and Culverts. December 1 to December 21.

Highway Engineering 106—Management Engineering. December 1 to December 21.

Highway Engineering 107—Mechanical Appliances Used in Highway Engineering. January 7 to January 25.

Highway Engineering 108—Non-Bituminous Road Materials. Laboratory Course. January 7 to January 25.

Highway Engineering 109—Planning of Roads and Road Systems. March 9 to March 22.

Highway Engineering 110—Planning of Streets and Street Systems. December 22 to January 6.

Highway Engineering 111—Seminar in Highway Engineering Literature. First Session. December to March, inclusive.

Highway Engineering 112—Seminar in Highway Engineering Literature. Second Session. December to March, inclusive.

Chemistry H199—Mining, Manufacture, Testing, and Inspection of Bituminous Materials. December 22 to January 6.

Chemistry H200—Testing of Bituminous Materials. Laboratory Course. January 26 to February 8.

Geology H215—Engineering Geology. January 26 to February 8.

Geology H216—Engineery Petrography. March 9 to March 22.

As far as amount and character of educational work are concerned, the sixteen courses, which have been previously described, fulfill the requirements for the degree of Master of Science at Columbia University. The University also requires that each candidate for the Master's Degree shall be in residence for one collegiate year or eight months. Candidates for the Master's Degree in the graduate course in highway engineering fulfill the requirement in one of three ways: first, by being in residence for one collegiate year or from October to May, inclusive; second, by being in residence for two winter periods from December to March, inclusive; and, third, by the distribution of residence over several years by being in attendance for parts of three or more winter periods. The University further requires that each candidate for a higher degree must hold a baccalaureate or engineering degree from an approved institution.

In considering the development of the graduate course, it is of interest to note the details of the records for registration for the 1915-1916 session. Twenty-seven American universities were represented by their graduates. The fifty men registered as graduate students were connected with the following fields of work:

| | |
|---|---|
| State highway departments | 8 |
| County highway departments | 5 |
| Municipal highway departments | 15 |
| Consulting engineers' offices | 6 |
| Contractors' engineering organizations | 11 |
| University faculties | 1 |
| Engineering departments of companies manufacturing road and paving machinery | 3 |
| Engineering, research, and chemical departments of companies manufacturing road and paving materials | 1 |

The widespread interest in the graduate course is shown by the following resume of the localities from which the graduate students came at the time of their registration for the 1915-1916 session: Denmark, New Zealand, Uruguay, Canada, Oklahoma, Connecticut, Massachusetts, New Jersey, Pennsylvania, New York, North Carolina, Texas, Oregon, Maine, Georgia, Louisiana, and Nebraska. It is of interest, as giving indication of the character and maturity of the graduate students, to note that the ages of the men varied from twenty-two to forty-five years and that several of them, at the time of entrance upon the graduate course, were receiving salaries of $3,000 to $5,000.

As indicative of the types of men who have been enrolled as graduate students in highway engineering, the following positions held by engineers and chemists at the time of enrollment are mentioned: Engineer of Maintenance, Department of Highways of the Borough of the Bronx, New York City; Superintendent of Asphalt Construction, Department of Public Work of Columbus, Ohio; Deputy Engineer, Virginia State Highway Department; Assistant Professor of Civil Engineering, Sheffield Scientific School, Yale University; Chemist, the American Asphaltum and Rubber Company; Assistant Engineer, Bureau of Highways of Manhattan, New York City; Superintendent of Public Works, Atlanta, Ga.; Professor of Highway Engineering, Georgia School of Technology; Engineer of Highways of Copenhagen, Denmark; County Superintendent of Highways of Ulster County, New York; United States Government Engineer to the Philippines; Deputy Engineer, Maryland State Highway Commission; Chief Engineer, Department of Parks of Detroit, Michigan; Chief Chemist, American Tar Company; Government Engineer of Roads and Bridges of Uruguay; Construction Engineer, Warren Brothers Company.

It is believed that a demand for graduate courses for practicing engineers exists and that the results secured by the establishment of the graduate course in highway engineering at Columbia University may be duplicated in all branches of engineering and applied science.

* * *

## North Carolina

*Caldwell County.* Lovelady Township, Caldwell County, has finished two and one-half miles of road during the last month. The camp disbanded June 15, as the $25,000 road money was about expended. Work here has been going on for thirteen months. They built twenty-seven and one-half miles during this time out of the $25,000.

*Surry County.* The Silvan Township, Surry County, roads done by contract have been completed. To keep the grades down to any reasonable limit required some very heavy construction, and about one-half mile of forty feet street through the village. The top soil was hauled a considerable distance, much of it being one and one-half miles, while there was an overhaul on nearly all of it. In spite of this the total cost of twenty-foot roads, including clearing, grading, drainage, and top-soil, with engineering, was about $1,800 per mile.

The Shoals Township, Surry County, roads are now being worked under a superintendent employed by the commissioners, and with the equipment of the former contractor. Conditions are favorable for a considerable cost reduction, as the teams and implements are rented at a reasonable rate, and will be turned back to the contractor at the completion of the work.

*Halifax County.* In Brinkleyville Township there has been seven miles of first-class sand-clay and gravel roads built at an average cost of $500 per mile, and six miles of second-class sand-clay roads at an average cost of $425 per mile.

In Littleton Township there has been built six miles of first-class clay and gravel roads at a cost of $500 per mile.

The maintenance work under the supervision of Mr. N. C. Hughes, Jr., has been going on quite satisfactorily for the past five months, and he figures that the maintenance cost per mile averages from $30 to $35 per mile per year; the maintenance crew being composed of a team and wagon and two men. All the work reported for the county, except maintenance, has been done by the county convict force. As near as Mr. Hughes can calculate they have been moving earth upon an average of from fourteen to fifteen cents per yard, and gravel from eighteen to twenty-two cents per yard, basing their figures on a twenty-day working month, which, of course, takes care of all over-head expenses. In Littleton Township they are just beginning to operate a contract force on a ten-mile stretch of road. It would be of interest to all to compare the cost of con-

struction of the same class of road between contract work and convict work.

*Alamance County.* In Alamance County they have built a small amount of top-soil road, having graded some over three miles, and have done some repair work on the dirt and macadam roads. Work on the Mebane-Trollingwood road has been started, and over 1,500 feet of soil has been put on.

*Avery County.* The Banner Elk-Newland road is expected to be completed early in July, concrete bridges having already been completed. The Newland-Linville connection with the Yonnahlossee Highway will be completed by the fifteenth. This will complete the belt route of highway from Blowing Rock via Linville, Newland, Banner Elk, Valle Crucis, Shulls Mills, and back to Blowing Rock, which circles Grand Father Mountain, a distance of fifty-seven miles. The Avery line between Elk Park and the Tennessee State line has been completed. By July 1, or early in July, from Tennessee State line to Plumtree, a distance of sixteen miles will be complete. The road from Newland to Linville Falls, via Miller Gap and Crossnore is now under construction, and about completed. Avery also has a connection with this line which will go to Pineola and Linville, which will be completed early in July.

*Franklin County.* Road building in this county has been done by township units. Four out of ten townships have voted bonds and built the more important roads. Now sentiment is strong and growing in the remaining townships, and there is a general demand for good roads, but low tax valuations prevent many townships from issuing bonds in sufficient amounts to buy proper equipment and leave working capital. To meet this condition a move is on foot to induce the county commissioners to buy mules and equipment and lend or rent it to the remaining townships, charging them enough to offset average replacement and wear and tear of the machinery. *Louisburg Township*: A small force with the mules are on repair and maintenance work while a larger number of convicts are at work digging foundations for the new reinforced concrete county bridge at Louisburg. *Youngsville Township*: Repair work is now being pushed and it is thought that maintenance will not again be neglected. *Cedar Rock Township*: $30,000 bonds recently voted are not yet sold; bids are being asked for. Construction will not be commenced until bonds are placed. *Dunns Township*: Bonds are being agitated, and an election is expected to be called soon.

*Vance County.* The two crews which are now in field No. 1, under the supervision of Theo. Rose, have built eight miles of road in the northern section of the county this year. This includes some important links near Towneville. Crew No. 2, under the direction of Cecillia Aquino, have built some over three miles known as the "Greenway" road. This crew is now about six miles northwest from Henderson building a link in the old Towneville road. Before the days of railroads this was a very important road, being on the "Big Road" to Fayetteville, which was the shipping point and market town for a large section of North Carolina.

*Wake County.* This county has just completed two miles of Warrenite pavement on the Glenwood and Louisburg roads. The Glenwood road, which leads to the Country Club, was built a few years ago by using Dollar-way pavement consisting of a concrete base five inches thick and a thin covering or blanket of asphalt. This was badly built and very unsatisfactory. Now they have dug under the edges and built a curb so that it would support the old base and put a Warrenite cover over the old Dollar-way pavement two inches thick and twenty feet wide. Before doing this, however, the old pavement was patched, taking out the worst parts and bringing the rest to a smooth and uniform subgrade with bituminous binder. This road is now the most beautiful drive leading out of Raliegh, and as it leads out to Bloomsbury Park and the Country Club, it is used extensively by motorists. This piece of pavement is twenty-one feet wide. The cost was $1.00 per square yard for paving and fifteen cents per lineal foot for curb.

On the Louisburg road there is only three-fourths of a mile of this pavement, but this sustains a very heavy travel by reason of the fact that four main highways converge and all the travel comes over this one road. This three-fourths of a mile had originally been built of water-bound macadam, under government supervision at a cost of about $22,000 but had worn badly and was very rough, in many places being worn entirely through. On this three-fourths of a mile was built a curb of about eighteen-inch base of concrete on each side which brought the old macadam to grade and a depth of not less than five inches with penetration macadam thoroughly rolled. On top of this was put a wearing surface of two-inch Warrenite. The paved portion of this is seventeen feet wide, and cost at the rate of $11,000 per mile, and this makes a very satisfactory pavement that will stand any amount of travel. Last year one mile of road, out by the A. & M. College on the Hillsboro road to the State Fair Grounds, was built of Warrenite with concrete base. This was constructed by R. G. Lassiter & Company, under the supervision of County Highway Engineer C. M. Miller, and has proven very satisfactory to the country people, as well as to the autorists in the city.

The North Carolina Good Roads Convention which was held at Wrightsville Beach June 22, 23, and 24, was decidedly the most successful and notable meeting in the interest of good roads ever held in the State. There were more than a thousand delegates registered. A number of notable speakers were heard, among whom were Hon. E. A. Stevens, President of the American Road Builders' Association; Hon. Leonard Tufts, President of the North Carolina Agricultural Society; Mr. C. A. Kenyon, Director of the American Highway Association of Indiana; Dr. Joseph Hyde Pratt, Secretary of the Association; Mr. W. S. Fallis, State Highway Engineer; Mr. D. H. Winslow, and Mr. J. E. Pennybacker, of the United States Office of Public Roads, and many other interesting and instructive speakers.

Among some of the subjects discussed was the Federal Aid Bill, the benefits to be derived therefrom; the automobile tax, the Association going on record as favoring such action on the part of the General Assembly of North Carolina as will make the funds received from said automobile tax or an equivalent amount thereto from the general funds, except a sufficient sum to cover the cost of issuing license tags, available for the maintenance of a system of State or inter-county highways to be spent under the direction of the State Highway Commission. The proper maintenance of roads already constructed was discussed, and it was pointed out clearly the great importance of properly maintaining the roads after they are built in some systematic manner.

Mr. H. B. Varner was re-elected president of the Association, Dr. Joseph Hyde Pratt was re-elected as secretary, and also elected as treasurer, and Miss H. M. Berry as assistant secretary.

* * *

## Kentucky

Kentucky has again come forward to show her practical road building spirit by naming public road working days on which the citizens of the Commonwealth are expected to take their shovels, hoes, picks, mattocks,teams and wagons and do actual labor in patching, repairing, draining, and constructing the highways of their localities.

Kentucky has ever maintained herself in the foremost rank in all public works, and although during the last ten years she fell somewhat behind her previous enviable record, for better roads she is now taking steps to again replace herself in her old position. Nineteen sixteen is the second year in which a public proclamation issued by the governor set forth road working days. The fact that the chief executive of the Commonwealth, Governor A. O. Stanley, sees fit to give his time and labor toward improving the highways is in itself sufficient evidence of the seriousness with which the people of Kentucky view road building. The governor's proclamation follows:

"In the interest of better roads in this Commonwealth, I now issue this, my proclamation, calling upon the people of every county of the State of Kentucky to work on the roads in their respective counties, on Monday and Tuesday, June the 12th and 13th, commencing at eight o'clock in the morning, each day, and continuing until five o'clock in the afternoon.

"The County Judge and Engineer of each county are directed to aid the people in complying with this request and in circulating the proper notices; and they are authorized to select such persons as may be needed to assist. In every county where there is no engineer, or where they fail to act, the sheriff or other persons, are authorized to organize and comply with this proclamation.

This proclamation refers to dirt roads, turnpikes, and gravel roads, and, as Kentucky always takes the lead in every movement, and as the Kentuckians desire the betterment of our highways, they must come forward with enthusiasm and energy and show the people of other States that they can equal or surpass them in the improvement of their roads.

"In testimony whereof, I have caused these letters to be made patent, and the seal of the Commonwealth to be hereunto affixed. Done at Frankfort the fifth day of June in the year of our Lord, one thousand, nine hundred and sixteen, and in the one hundred and twenty-fifth year of the Commonwealth.

Seal (Signed) A. O. Stanley,
Governor of Kentucky.

By the Governor.
(Signed) J. P. Lewis, Secretary of State.
By Chas. W. Howes, Asst. Secretary of State."

Besides starting engineering, it supplied the enthusiasm for the road work on June 12 and 13. Governor Stanley himself secured a shovel and personally lead the forces in Franklin county in their laudable undertaking of improving the main thoroughfare of the Boone Highway.

It is an inspiring sight to see a great crowd of merchants, bankers, State and county officials, farmers and day laborers all engaged in the same occupation of improving the public highway. Then, when one considers that a like crowd of enthusiastic men are so engaged in every county in the State on the same days, one realizes the great good that comes of such unselfish public-spirited labor. Of course, it is not expected that any great number of unskilled men could devote two days of their time and actually finish a stretch of road that is surfaced with water-bound macadam or any such character of surfacing that requires the use of machinery, but it undoubtedly is true that these men may do a vast amount of good by providing unobstructed drainage ways, by preventing rutting, by patching, and draining mud holes and chug holes and by cutting brush, weeds, and over-hanging limbs. Doubtless twenty thousand dollars worth of work has been done for Kentucky roads through the simple issuing of the governor's proclamation and the enthusiastic support it deservedly received.

* * *

## In West Virginia

That West Virginia is awake to the cause of better roads is evidenced by the amount of funds that have been appropriated and voted during the past two years. On June 20, Brooke County voted a bond issue of $800,000 bringing the total available funds for road purposes up to more than $10,000,000 and the total authorized bond in the State up to $12,388,500. All of this amount has been voted since November, 1911, and $11,508,500 has been voted during the past two years.

On June 17, the county court of Ritchie County sold $240,000 Clay district bonds to Otis & Company at a premium of $1,805 and will advertise for bids on eighteen miles of construction as soon as plans and specifications can be prepared, W. D. Britt, Clarksburg, in charge.

The county court of Wood County has recently sold $70,000 Tigart district bonds at a premium of $100 to the local banks in Parkersburg. Work will be done by force account under direction of Burdette Woodward, county engineer, who has proven himself a master at constructing concrete road.

The county court of Roane County sold $240,000 Spencer district bonds to Harris Forbes & Company at a premium of $650 and the blank bonds.

The county court of Raleigh County has recently sold $835,000 Shady Spring, Trap Hill, Slab Fork, and Town district bonds at a premium of $10,742.50 and are now preparing to carry out the necessary arrangements to start the construction.

The county court of Summers County has awarded the contract for eight miles of asphaltic concrete to the Central Engineering Company at Charleston, West Virginia, F. K. Rader, Lewisburg, Phillip J. Konrad, Kanawha Falls, engineers in charge.

The county court of Hancock County has recently sold $125,000 Grant district bonds, $50,000 Poe district bonds, $40,000 Clay district bonds and are now having surveys made preparatory to advertising for bids, C. E. Grafton, New Cumberland, engineer, in charge.

Logan District, Logan County, has voted $200,000 five per cent. serial bonds. F. M. Wilson, county engineer, Logan, West Virginia, is making surveys and preparing plans and specifications.

The county court of Doddridge County has decided to do the work in Grant district under the $175,000 bond issue by force account and have employed Arthur Lucas, civil engineer of Morgantown, West Virginia, to take charge of the work. The same county has rejected all bids on the West Union district work excepting the bid of Sisler & Morse, who have been awarded the contract for four miles.

The citizens of Lubeck district, Wood County, New Creek district, Mineral County, and Piedmont district, Mineral County, voted on $385,000 of bonds Saturday, June 24.

* * *

## Oklahoma Department of Highways

The excessive floods occuring on the North Canadian River and on Wolf and Beaver Creeks which unite to form this stream near Fort Supply, in Woodward County, caused almost incalculable damage to farm land and growing crops along the streams and did probably $50,000 damage to bridges and roads in the counties where the heaviest rains occured. Ellis, Woodward, Woods, Blaine, and Harper counties lost all or part of practically every bridge in the Canadian Valley and traffic was at a standstill for over ten days.

At the request of the commissioners of Ellis County, the State engineer left Oklahoma City for Shattuck to see what could be done to make a crossing at that point as the south approach to the Wolf Creek bridge was entirely washed away. On his arrival at Woodward, he was met by the county commissioners and in their company made inspection of the situation at the site of the bridge under construction across the North Canadian just north of the city of Woodward. The river at this point had changed its channel some 600 feet, leaving the old combination bridge and the partially completed sub-structure of the new arch rib bridge entirely north of the new channel and on a sand bar that was more than a foot higher than the former north bank of the river.

The Wolk Creek bridge at Gage was intact, but the north approach was badly washed and the tubular pier between the channel spans was pushed about eighteen inches out of plumb by a floating cottonwood tree that hung up on the pier when the flood was at its height. The road at Gage, on the north side of Wolf Creek was entirely washed out for a distance of more than two miles, and the citizens of that town had to organize a force to remove the sand beds that were washed up on the old road.

The greatest damage was confined to Ellis and Woodward counties, but the counties down stream suffered considerably. Blaine County lost several trestle approaches to river bridges and Canadian County suffered quite a little damage but the banks of the river change their character within the limits of this county, changing from the low sandy banks characteristic of the upper portions of this stream to the high mud and rock banks found in Oklahoma and Pottawatomie counties.

It has been pretty conclusively proved by this flood that it is impossible to forecast the extreme limits of floods that may be attained in the future and also that it is not an economic possibility to build openings to pass the maximum possible floods on streams of this character. The flood waters are heavily laden with silt and the channels in general choked with cottonwood, willow, and other brush and as it is invariably characteristic of such streams that the banks are comparatively high and that there are openings for overflow along the bluffs on one or both sides of the stream, the result is that the channels are building up instead of scouring out and each big rise has a tendency to exceed its predecessors.

The result of the above circumstances is practically the same as has occurred on the lower reaches of the Mississippi River, in the levee districts and has had the effect of cutting the river proper off from the bluffs by side channels that run deep in time of overflow and prevent access to the opening built over the main channel to pass the ordinary flow. It is a financial impossibility to bridge the entire valley with a structure that will pass the maximum flood, in addition to the

fact that there is no way of telling where the maximum flood will reach; and, as it is impossible to reach a bridge across the channel of the main river when the overflow channels are full, beside the fact that such a bridge is endangered by floating trees, etc., when the stream is in flood, it has been decided in some of the counties, and recommended by the department of highways, that concrete slab bridges, set only a foot or so above the normal low-water level be built to pass the normal flow of the stream and to be overflowed by flood stages. These bridges to have wire handrails that can be lost without much expense and the saving over a bridge of the customary type to be spent in adding length. It is the idea that such a bridge will offer so little resistance to the flood water as to come out undamaged and, as it is impossible to reach the main stream at flood time in any case, the extra length will save reconstruction of earth approaches. Woodward County has adjusted their contract with the Woodward Cement and Concrete Company for the sub-structure of the bridge north of the city of Woodward in such a manner as to go ahead without delay on the construction of a bridge of this type at that point, making use of all completed work on the original contract.

Commissioner Noble, accompanied by the county commissioners and State engineer made an inspection of about eighty miles of the State roads in Oklahoma County, taking dinner at the convict camp east of Edmond on the road being built to carry the Ozark trail on high ground from Luther to Oklahoma City. This work has been in progress all winter with a force of teams and with city and county convicts and the whole work reflects great credit on the county commissioners and their organization.

The State engineer made inspection of practically all the State road mileage in Caddo County, in the company of Commissioners Vollmer and Ratcliff. This county has done most excellent work in the way of surfacing their roads, over 250 miles of their mileage being a dragable condition and some of the roads, notably the one east from Anadarko to the Grady County line and the roads in the vicinity of Fort Cobb and north of Carnegie, being in condition that would be a credit to an earth surface speedway. This is the more creditable as these bottom roads were practically impassable in previous years after the usual spring floods. A large portion of the work in Caddo County has been done by county convicts and the balance by team and machine grading. Caddo County owns two gas tractors and four teams of mules and the commissioners contemplate purchasing a small crusher at some future time as there is an abundance of limestone in the county that would make good road material.

* * *

## Concrete Roads in West Virginia

While the good roads boosters of West Virginia are advocating and building permanence into their State highways by the use of concrete, they are, nevertheless, taking advantage of all opportunities to better the condition of their dirt roads, this being evidenced by the extensive observation of Governor H. D. Hatfield's proclamation of Good Roads Days July 18 and 19. The celebration this year, which was the third during the administration of the present governor, was not confined to any particular locality, scores of farmers, laborers, merchants, professional men, and automobilists improving large sections of bad roads all over the State. The movement this year represented an organized effort and consequently better results were obtained than were evidenced from the two previous efforts.

Each county carried on its own work and the boosters centered their efforts on a particular kind of work and on a selected piece of road. The bulk of the work consisted in grading, draining, ditching, and crowning the surface of the dirt road by the use of the famous split road drag. Scores of miles were improved but not until each county makes its report to State Road Engineer A. D. Williams, will the exact mileage improved be known. The women of the State, particularly the suffragists, rendered efficient services, confining their efforts for the most part to the serving of meals to the road workers. One of the most encouraging features of the celebration was the remarkable interest manifested by the farmers of the State, who are rapidly awakening to the benefits and advantages derived from better roads. They were found in the foreground in practically every county in the State and worked side by side with attorneys, ministers, bankers, automobilists, and men from other walks of life.

Bond issues for the permanent improvement of highways continue to be voted. Brooke County celebrated the fifty-third anniversary of the founding of the State, June 15, by voting $800,000, one of the largest amounts to be voted by a county in the State. Two districts in Mineral County, Piedmont and New Creek, voted the total of $285,000 on June 24 for the permanent improvement of the main roads of the two districts. In other counties, good roads associations are being formed with the end in view of passing bond issues. In this work, the Portland Cement Association is rendering invaluable aid and in order to obtain the greatest efficiency, larger, and more commodious State headquarters have been opened in Parkersburg by division engineer, G. B. Arthur.

The Association opened its "Service Station" in three well equipped office rooms in the Union Trust Company Building in Parkersburg July 15, and Mr. Arthur has surrounded himself with an able corps of assistants. The Association is now working hand-in-hand with the progressive people of the State who realize that if West Virginia desires to keep pace with her sister States, she must build permanent roads.

Wood County is now to West Virginia what Wayne County is to Michigan, and it is a common sight here at present to see parties of good roads boosters from all sections of the State inspecting the concrete roads and streets constructed by County Engineer Burdette Woodyard. Preston County is the latest county to adopt concrete for its permanent highways, the officials there desiring to build more permanence into their roads than exists in the fine roads in Maryland.

While the citizens of West Virginia are in the throes of a spirited political campaign, in which the women are waging a fight for equal rights, they are, nevertheless, manifesting as much interest in the permanent improvement of their highways as they are in the election of county, State, and national officers.

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## Washington

Program so far arranged for the annual meeting of the Washington State Association of County Commissioners, in Tacoma, Washington, September 14, 15, and 16, 1916.

Address of Welcome—Governor Earnest Lister, Governor State of Washington.

Greater Efficiency and Economy in County Government—Hon. Rufus C. Holman, President Oregon State Association County Judges and Commissioners, Portland, Oregon.

County Pavements—Hon. R. H. Thomson, Consulting Engineer, Seattle, Washington.

California State Highway Work—Hon. Austin B. Fletcher, Chief Engineer State Highways of California, Sacramento, California.

Highways of the State of Oregon; Laws, Construction, and Maintenance—Hon. John H. Lewis, Chief Engineer State Highways of Oregon, Salem, Oregon.

Location and Construction of State Roads; also Relation of Highway Commissioner's Office with County Commissioners in Matter of Permanent Highway Law—Hon. James Allen, Highway Commissioner State of Washington, Olympia, Washington.

Highway Bridges—Dean A. H. Fuller, Dean of College of Engineering, University of Washington, Seattle, Washington.

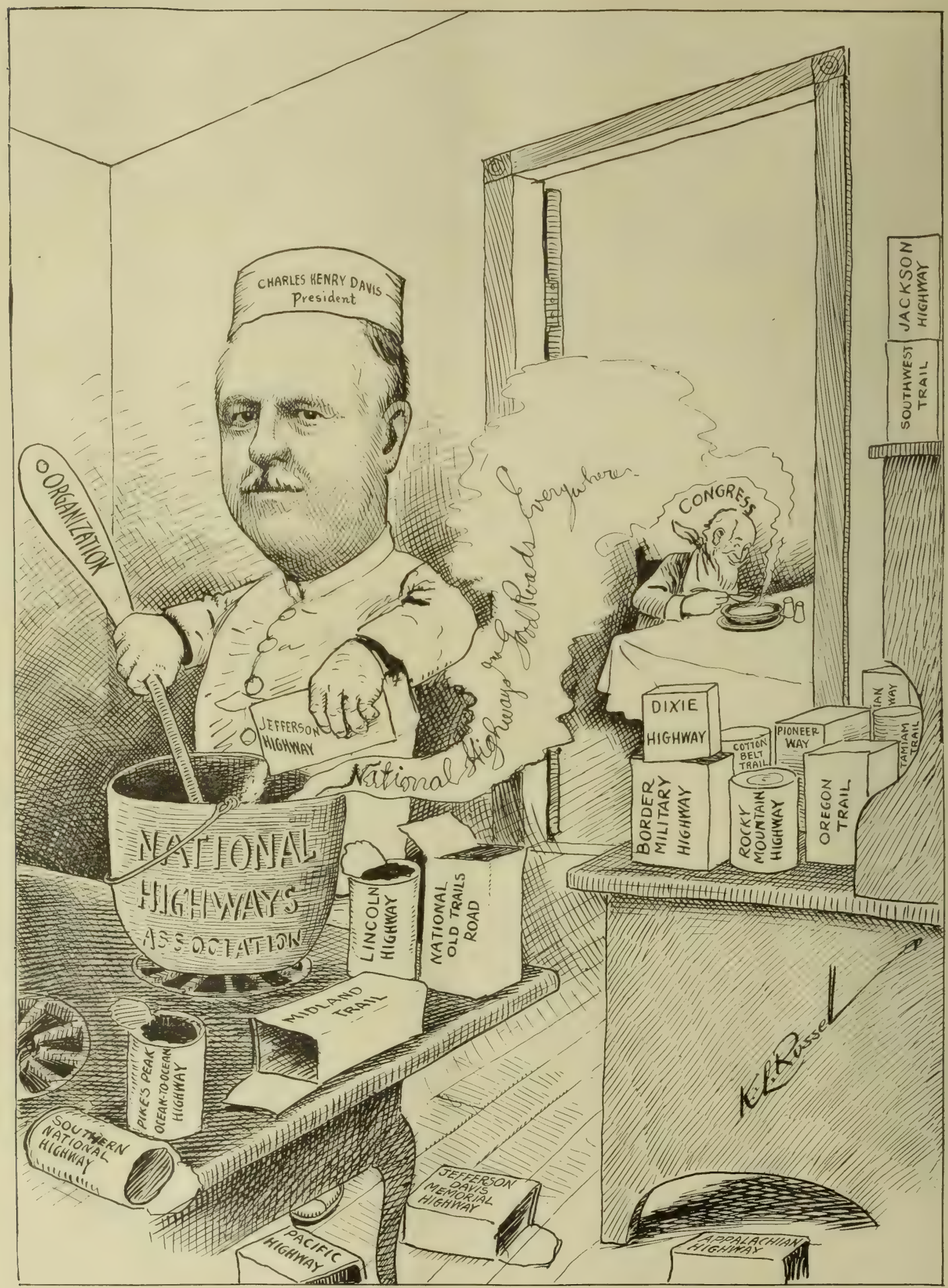
Experimental Research as Applied to Road Materials—Dr. H. K. Benson, Professor of Industrial Chemistry, University of Washington, Seattle, Washington.

Maintenance of Earth and Gravelled Roads—Professor William F. Allison, Professor of Municipal and Highway Engineering University of Washington, Seattle, Washington.

Legislation Committe's Report on County Government Legislation, with Suggestions and Remarks thereon—Hon. J. T. S. Lyle, Chairman Legislative Committee Washington State Association County Commissioners, Tacoma, Washington.

Subject for Toastmaster at Banquet—Is it Better for County Commissioners to have a Short Memory than a Clear Conscience?—Mr. Frank B. Cole, Toastmaster.

On September 14, a joint session will be had of the State Associations, of County Commissioners, County Engineers, and City Engineers.




THE SAVOR OF THE MEAL DID AROUSE THE HOST

# Philadelphia's Concrete Service Test Road

By William H. Connell, Chief of the Bureau of Highways

THE comparative quality of pavements, whether for city streets or for country roads, can be determined only through service tests under similar traffic and climatic conditions, and also when different theories exist relative to the proper materials to employ, or methods of construction to follow with respect to certain types of pavements, such as concrete. actual service tests under similar conditions form the only true criteria, so that a service test roadway consisting of different sections, constructed according to the latest theories of the experts on this subject, is necessarily an invaluable guide in concrete road construction.

With this object in view, it was decided to build a service test concrete roadway on the Oxford pike, from the northeast Boulevard to Rising Sun Avenue, Philadelphia, Pennsylvania, the length of which is 11,250 feet, or about 2.1 miles.

The construction of this service test roadway was started on October 5, 1914, and continued until December 4, of the same year, when, on account of cold weather, work was suspended until March 30, 1915. The concrete was completed on May 18, 1915, sixty-six working days being actually consumed in the concrete construction and the preliminary work incident to this construction. The lateness of the season in which this work was done indicates that some of the construction was not done under the most favorable conditions, and it is, in a measure, instrumental for some of the rather high costs. In all cases when the temperature was below the freezing point, the road was covered with hay or canvas. The bituminous surfacing materials were all applied between August 26, 1915, and September 14, 1915.

The total length of the road was divided into five principal sections, each of which was made 2,250 feet long. Each of these principal sections was constructed of different materials and in varying proportions. These five principal sections were further subdivided into two sections, one of which, 1,050 feet in length, was left uncovered. The remainder of each principal section was therefore 1,200 feet in length, and this section was treated with four different bituminous wearing surfaces, the length of each of these surface treatments being 300 feet. The bituminous materials employed for these wearing surfaces were Tarvia, Ugite, asphalt cut-back, and Unionite.

*Cross Section.* The cross section of the pavement was uniform throughout the entire length of the road, being eighteen feet in width with a thickness of seven and one-quarter (7¼) inches at the center, six and one-half (6½) inches at the quarter points, and five (5) inches at the side, or edges. The bottom was a flat plane. This cross section is the one generally recognized by experts as producing the best results, so that it was not considered necessary or advisable to experiment further with any other cross section.

*Foundation.* The pavement was built on an old water-bound macadam roadway, the latter varying from nine to eighteen inches in depth. This was first spiked and then scarified and the macadam removed to a depth of five inches below the desired finished grade, after which it was thoroughly rolled with a ten-ton, three-wheeled roller.

*Concrete Pavement.* The concrete used in the pavement was composed of one part Portland cement, two parts fine aggregate, and three parts coarse aggregate, varying in the different sections as to materials composing the aggregates. The mixing was all done in a Ransome concrete mixer which was equipped with a charging device. The surface of the concrete was finished with a template cut to the cross section of the road, and it was then floated with wooden floats from a movable bridge built to span the concrete surface.

*Joints.* Transverse joints were provided at intervals of thirty feet, and with the exception of ten joints which were laid at an angle of thirty degrees, all of the joints were laid at right angles to the axis of the roadway. Two types of joints were used:

1. Prepared bituminous joints.
2. Steel protected joints.

The prepared bituminous joints consisted of a one-quarter-inch prepared felt which extended through the entire thickness of the concrete. In order to secure straight joints, especially on the grades, and to facilitate the placing of the bituminous material, one-quarter-inch iron plates were placed across the road at each end joint with the felt against it, and when the concrete had been poured in place, this iron plate was removed.

The steel protected joints consisted of plates two and one-half inches in depth, one-quarter-inch thick, manufactured by the Trussed Concrete Steel Company, Youngstown, Ohio. These joints were installed with the "Truss-Con" holding device, which was removed as soon as the concrete was placed, one-quarter-inch prepared felt extending through the entire thickness of the concrete was used between these plates.

### THE BITUMINOUS SURFACES

*Tarvia.* After sweeping the surface of the concrete thoroughly, one-fifth gallon per square yard of Tarvia "B" was applied with a pressure distributor. Then after this had thoroughly dried, one-fourth gallon per square yard of Tarvia "A" was applied by the pressure distributor. The Tarvia "A" was applied at a temperature of 250 degress Fahrenheit. It was then covered with a thin layer of one-half inch clean trap rock chips, about ten pounds per square yard being the average



**Oxford Service Test Road Before Improvement.**

quantity applied. Three days later, a second coat of Tarvia "A"—one-fourth gallon per square yard—was applied with the pressure distributor, and this was then covered with another layer of clean trap rock chips, about twenty pounds per square yard being applied in this case.

*Ugite.* After sweeping the surface of the concrete thoroughly, one-tenth to one-eighth gallon per square yard of Ugite "A" was applied with a pressure distributor, and this, after two hours, was covered with a thin layer of one-half inch clean trap rock chips, about ten pounds per square yard being applied. The following day, one-third to three-tenths gallon per square yard of Ugite, No. 3 was applied at a temperature of 250 degrees Fahrenheit, by a pressure distributor, and this was, in turn, covered with a thin layer of one-half inch clean trap rock chips (about twenty pounds per square yard). The following day, the second application of Ugite No. 3, also from one-third to three- tenths of a gallon per square yard, was applied with the pressure distributor. This was then covered with twenty pounds to the square yard of one-half inch clean trap rock chips and the application rolled lightly with a five-ton roller.

*Asphalt Cut-Back.* After sweeping the surface of the concrete thoroughly, a paint coat consisting of fifty per cent. naphtha and fifty per cent. of asphalt, the latter having a penetration of from fifty-five to sixty-five, and in an amount of one-eighth gallon per square yeard was applied with a pressure distributor. Twenty-four hours later an application of one-third gallon per square yard of asphalt with a penetration of from seventy to eighty, cut-back with from thirty-five to forty per cent. of naphtha was applied with a pressure distributor. After two hours this was covered with a layer of trap rock chips graded from one-eighth to one-half inch (about

twenty-five pounds to the square yard), and the whole was then thoroughly compacted with a five-ton roller.

*Unionite.* After the concrete surface has been thoroughly cleaned, a paint coat consisting of equal parts of asphalt with a penetration of from fifty-five to sixty-five, and naphtha, in an amount of one-eighth gallon per square yard was applied with a pressure distributor. On the following day, Unionite wearing surface was spread and rolled with a ten-ton roller. The thickness of this wearing surface was from one-fourth to three-eights of an inch after rolling. The Unionite consisted of specially prepared rock asphalt, one-quarter-inch crushed stone and Unionite asphaltic cement in the proportion of forty-seven and one-half per cent. rock asphalt, two and one-half per cent. asphaltic cement, and fifty per cent. stone, the latter previously coated with asphaltic cement.

SPECIFICATIONS FOR THE MATERIALS USED

*Stone Grit.* The stone grit shall consist of screenings from clean, hard crushed trap rock graded from fine to coarse, with



**Placing concrete, Ransome mixer, Trussed Concrete Steel Co. steel protection plates and side forms**

the coarse particles predominating, and passing when dry a screen having one-quarter inch openings. It shall be clean, hard, free from dust, loam, vegetable, or other deleterious matter. Not more than fifteen per cent. shall pass a sieve having fifty meshes per lineal inch, and not more than five per cent. shall pass a sieve having 100 meshes per lineal inch. The strength of the stone grit when mixed in briquettes of one part cement and three parts grit shall not be less than the tensile strength of similar briquettes mixed with one part cement and three parts Ottawa sand.

*Sand.* The sand shall be graded from coarse to fine, not exceeding one-fourth inch in diameter. It shall contain not more than five per cent. of material removed by the elutriation test, and shall be equal to the best New Jersey bank sand or gravel. The strength of the sand when mixed in briquettes of one part Portland cement and three parts sand shall not be less than the tensile strength of similar briquettes mixed with one part Portland cement and three parts Ottawa sand.

*Crushed Stone.* The stone shall be an approved clean, hard, cubical crushed limestone with a co-efficient of wear of not less than ten, or trap rock with a co-efficient of wear of not less than fifteen, or gravel. It shall pass a one and one-half (1½) inch ring and shall be retained on a one-quarter (¼) inch screen, and shall be uniformly graded. Care shall be taken that the stone or gravel as used is mixed as to size.

*Steel Protected Joints.* Transverse joints shall not be less than one-quarter (¼) inch nor more than three-eighths (⅜) inch in width, and shall be placed across the pavement perpendicular to the centerline, not more than thirty feet apart. All joints shall extend through the entire thickness of the pavement, and shall be perpendicular to its surface. The concrete at transverse joints shall be protected with soft steel protection plates which shall not be less than two and one-half inches in depth and not less than one-eighth (⅛) inch or more than one-quarter (¼) inch average thickness. The plate shall be of such form as to provide for rigid anchorage to the concrete. The type and method of installation of joint protection plates shall be approved by the engineer. The surface edges of the metal plates shall conform to the finished surface of the concrete.

All joint protection plates over one-quarter (¼) inch high or one-half (½) low shall be removed.

*Joint Filler.* All joints shall be formed by inserting during construction and leaving in place the required thickness of prepared felt or similar material of approved quality, and having a thickness of not less than one-eighth (⅛) inch nor more than one-fourth (¼) inch, which shall extend through the entire thickness of the pavement.

*Bituminous Expansion Joints.* Bituminous expansion joints shall be placed across the pavement perpendicular to the center line, and spaced not more than thirty (30) feet apart. They shall be formed by inserting, during construction, and leaving in place, an approved tar or asphalt prepared joint filler having a thickness of not less than one-eighth (⅛) inch nor more than one-quarter (¼) inch, which shall extend through the entire thickness of the pavement.

SPECIFICATIONS FOR TARVIA

Upon the thoroughly cleaned concrete shall be placed with a pressure distributor a bituminous priming coat of Tarvia "B" of one-fifth of a gallon per square yard. After the priming coat has thoroughly dried into the concrete, there shall be applied with a pressure distributor a first coat of Tarvia "A" of one-fourth of a gallon to the square yard. After the first coat has been applied, there shall be spread a layer of clean, hard trap rock chips with a co-efficient of wear of not less than fifteen, and which will pass a one-half inch screen and be retained in a number ten screen. Only sufficient chips shall be used to prevent the distributing machine from sticking to the coat that has been applied.

As soon after the application of the first coat as the chief of the bureau shall determine, there shall be applied with a pressure distributor a second coat of Tarvia "A" of one-fourth gallon to the square yard, and upon this second coat there shall be spread a thin layer of clean trap rock chips with a co-efficient of wear of not less than fifteen, and which will pass a one-half inch screen and be retained on a number ten screen.

*Specification for Tarvia "B."* The specific gravity shall not be less than 1.14, nor more than 1.18 at sixty degrees Fahrenheit.

The viscosity tested by the standard Engler viscosimeter shall not be more than one hundred seconds for 100 cubic centimeters at 140 degrees Fahrenheit.

On distilling 100 grams of the material at 500 degrees Fahrenheit, the residue shall not be less than seventy grams. This



**Ransome Mixer placing concrete, using template and floating surface from the bridge**

residue shall be a soft pitch at sixty degrees Fahrenheit. If the residue appears hard, it shall be tested for melting point, and this melting point shall not exceed 140 degrees Fahrenheit by the one-half inch cube method.

The free carbon shall not be less than four per cent.

In making the foregoing tests, the following methods shall be employed:

SPECIFIC GRAVITY

The specific gravity shall be determined by the use of a Hubbard type of specific gravity bottle. The bottle shall be filled with the liquid material at a convenient temperature. The bottle shall then be kept in a water bath at sixty degrees Fahrenheit until the level of the liquid, after adjustment to the mark, shows no further contraction. The bottle shall then be weighed. The weight of the material, divided by the weight of the same volume of freshly boiled distilled water at sixty degrees Fahrenheit, is the specific gravity.

DISTILLATION

One hundred grams of the material shall be distilled in an eight-ounce glass retort according to the standard method for



**Road covered with earth as protection against the sun. Man sprinkling covering in the distance**

distilling creosote oil, as described in Bulletin No. 65 of the American Railway Engineering and Maintenance of Way Association. The retort shall be weighed and exactly one hundred grams of the material weighed in the retort shall be used. The thermometer shall be inserted in the retort with the lower end of the bulb one-half inch above the surface of the material, and the condensing tube shall be attached to the retort by a tight cork joint. The distance between the bulb of the thermometer and the end of the condensing tube shall not be less than twenty inches nor more than twenty-four inches, and during the progress of the distillation, the thermometer shall remain in the position in which it was originally placed.

The distillate shall be collected in weighed flasks, and fractions shall be determined by weight.

Receivers shall be changed when the thermometer records a temperature of 338 degrees Fahrenheit. When the thermometer records a temperature of 500 degrees Fahrenheit, the flame shall be removed. The distillation shall be continuous and the oil shall come over at the rate of one to two drops per second.

MELTING POINT

A clean shaped one-half inch cube of the material shall be formed in the mould, placed on a hook of Number 12 (B. & S. Gauge) copper wire, and suspended in a 600 cubic centimeter beaker so that the bottom of the cube shall be one inch above the bottom of the beaker. A piece of paper placed in the bottom of the beaker and conveniently weighted will prevent the pitch from sticking to the beaker when it drops off. The cube shall remain for five minutes in 400 cubic centimeters of freshly distilled water kept at a temperature of forty degrees Fahrenheit before any heat is applied. Heat shall be applied in such a manner that the temperature of the water shall be raised nine degrees Fahrenheit each minute. The temperature recorded by the thermometer at the instant the material touches the bottom of the beaker shall be the melting point.

FREE CARBON

The free carbon shall be determined by making a hot extraction of five to ten grams of material with C. P. Toluol, followed by C. P. Benzol, or C. P. Benzol followed by Chloroform as solvents. The extraction shall be made in a Soxhlet, a Knorr, an Underwriters' or some other suitable and approved extraction apparatus. The distillation of the solvent shall be continued until the washings run through practically colorless.

VISCOSITY

The viscosity shall be determined in a standard Engler Viscosimeter at 140 degrees Fahrenheit. Sufficient material shall be placed in the viscosimeter to bring the surface of the liquid to a level with the tops of the three leveling points. The time required to discharge 100 cubic centimeters shall be recorded as the viscosity.

*Specification for Tarvia "A."* The specific gravity shall be not less than 1.19 at sixty degrees Fahrenheit.

The viscosity tested by the standard Engler Viscosimeter shall be not less than 125 seconds nor more than 200 seconds for 100 cubic centimeters at 212 degrees Fahrenheit.

On distilling one hundred grams of the material, no distillate shall come over below 338 degrees Fahrenheit. The distillation shall be continued at 600 degrees Fahrenheit. The specific gravity of the entire distillate shall be not less than 1.03 at sixty degrees Fahrenheit. The residue from the foregoing distillation shall have a melting point not greater than 165 degrees Fahrenheit.

The free carbon shall be not less than ten per cent. nor more than twenty-five per cent.

In making the foregoing tests, the following methods shall be used:

SPECIFIC GRAVITY

The specific gravity shall be determined by the use of a Hubbard type specific gravity bottle. Approximately ten grams of melted material shall be placed in the weighing bottle and the weight taken after cooling. Freshly boiled distilled water shall be added and the bottle kept in a bath at sixty degrees Fahrenheit until no further contraction takes place. The water shall then be adjusted to the mark and the bottle removed from the bath and weighed. The weight of the material divided by the weight of the water displaced is the specific gravity.

DISTILLATION

One hundred drams of the material shall be distilled in an eight ounce glass retort according to the standard method for distilling creosote oil, as described in Bulletin No. 65 of the American Railway Engineering and Maintenance of Way Association. The retort shall be weighed, and exactly one hundred grams of the material weighed in the retort shall be used. The thermometer shall be inserted in the retort with the lower end of the bulb one-half inch above the surface of the material, and the condensing tube shall be attached to the retort by a tight cork joint. The distance between the bulb of the thermometer and the end of the condensing tube shall be not less than twenty nor more than twenty-four inches, and during the progress of the distillation the thermometer shall remain in the position originally placed.



**The completed road opened to traffic. Note excellent sight line on double reverse curve**

The distillate shall be collected in weighed flasks, and fractions shall be determined by weight.

Receivers shall be changed when the thermometer records a temperature of 338 degrees Fahrenheit, and when the thermo-

meter records a temperature of 600 degrees Fahrenheit, the flame shall be removed. The distillation shall be continuous, and the oil shall come over at a rate of one to two drops per second.

MELTING POINT

A clean shaped one-half cube of the material shall be formed in the mould, placed on a hook of No. 12 (B. & S. Gauge) copper wire, and suspended in a 600 cubic centimeter beaker so that the bottom of the cube shall be one inch above the bottom of the beaker. A sheet of paper placed on the bottom of the beaker and conveniently weighed will prevent pitch from sticking to the beaker when it drops off. The cube shall remain five minutes in four hundred cubic centimeters of freshly distilled water kept at a temperature of forty degrees Fahrenheit before heat is applied. Heat shall be applied in such a manner that the temperature of the water shall be raised nine degrees Fahrenheit each minute. The temperature recorded by the thermometer at the instant the material touches the bottom of the beaker shall be the melting point.

FREE CARBON

The free carbon shall be determined by making a hot extraction of five to ten grams of material with C. P. Toluol, followed by C. P. Benzol, or C. P. Benzol followed by Chloroform as solvents. The extraction shall be made in a Soxhlet, Knorr, Underwriters', or some other suitable extraction apparatus. The distillation of the solvent shall be continued until the washings run through practically colorless.



**Oxford Pike Service Test Road Completed**

VISCOSITY

The viscosity shall be determined in a standard Engler Viscosimeter at 212 degrees Fahrenheit. Sufficient material shall be placed in the viscosimeter to bring the surface of the liquid to a level with the tops of the three leveling points. The time required to discharge one hundred cubic centimeters shall be recorded as the viscosity.

*Specification for Ugite.* Upon the thoroughly cleaned and dry concrete shall be applied with a pressure distributor, an application of Ugite A at the rate of one-tenth to one-eighth of a gallon to the square yard. At the expiration of at least two hours after the application of Ugite A, there shall be spread a thin layer of clean trap rock chips with a co-efficient of wear of not less than fifteen (15), and which will pass a one-half-inch screen and be retained on a Number 10 screen. Upon the Ugite A and chips there shall be applied by a pressure distributor a coating of Ugite Number 3 at a temperature of from 225 to 250 degrees Fahrenheit, at the rate of one-third to three-tenths of a gallon to the square yard. Upon this application of Ugite Number 3 there shall be spread a layer of clean trap rock chips with a co-efficient of wear of not less than fifteen, and which will pass a one-half-inch screen and be retained on a Number 10 screen. This should then be lightly rolled with a five-ton roller.

Upon this first application of Ugite Number 3 and chips, there shall be applied with a pressure distributor a second coat of Ugite Number 3 as directed for the first application, at the rate of one-third to three-tenths of a gallon to the square yard. The second application shall be covered with a thin layer of clean, hard trap rock chips with a co-efficient of wear of not less than fifteen, and which will pass a one-half-inch screen and be retained on a Number 10 screen. This application shall also be lightly rolled with a five-ton roller.

SPECIFICATION FOR UGITE A

Specific gravity at twenty-five degrees Centigrade, 1.09-1.12.

Solubility in carbon bisulphide at room temperature, not less than ninety-seven per cent.

Viscosity in Engler Viscosimeter, first fifty cubic centimeters at forty degrees Centigrade, 60"-100".

When 100 cubic centimeters are distilled in a 250 cubic centimeter Engler flask according to the method proposed by the American Society for Testing Materials, it shall show the following fractions by weight:

Start to 170 degrees Centigrade, not more than three per cent.

Up to 235 degrees Centigrade, not more than twenty per cent.

Up to 270 degrees Centigrade, not more than thirty-seven per cent.

Up to 300 degrees Centigrade, not more than fifty per cent.

Melting point of residue by cube method, not more than sixty degrees Centigrade.

SPECIFICATION FOR UGITE NUMBER 3

Specific gravity at twenty-five degrees Centigrade, 1.15 to 1.175.

Solubility in carbon bisulphide at room temperature, not less than ninety-seven per cent.

When tested in New York testing laboratory float test at 100 degrees Centigrade, the float shall sink in from twenty to twenty-four minutes.

When 100 cubic centimeters are distilled in a 250 cubic centimeter Engler Viscosimeter according to the method proposed by the American Society for Testing Materials, it shall show the following fraction by weight:

Start to 170 degrees Centigrade, not more than one-half per cent.

Up to 235 degrees Centigrade, not more than three per cent.

Up to 270 degrees Centigrade, not more than twelve per cent.

Up to 300 degrees Centigrade, not more than twenty-five per cent.

Melting point of residue by cube method, not more than sixty-five degrees Centigrade.

*Specification for Asphalt Cut-Back.* Upon the thoroughly cleaned concrete shall be placed with a pressure distributor a bituminous paint coat of one-eighth gallon to the square yard —the materials and method conforming to that specified in the standard specifications.

Not more than twenty-four (24) hours nor less than six (6) hours after applying the paint coat, a second application shall be laid. This second application shall be the same as the first, except that the proportion of naphtha shall be thirty-five to forty per cent., and the penetration of the asphalt between seventy and eighty. One-third gallon to the square yard shall be used on this second application.

After about two hours there shall be spread evenly on the bituminous material dry, clean, trap rock chips, graded in size from one-eighth-inch to one-half-inch, in an amount from twenty to thirty pounds to the square yard, and rolled with a light steam roller until thoroughly compacted.

BINDER

*Specification for Unionite.* After the concrete base has been prepared in accordance with the specifications, and has developed hard set, and just prior to placing the wearing surface, the base shall be thoroughly cleaned of all loose or foreign material by sweeping with wire brooms and then covered with Unionite binder, consisting of equal parts by volume of asphaltic cement having a penetration of fifty-five to sixty-five at a temperature of seventy-seven degrees Fahrenheit with a Dow penetrometer using Number 2 needle and a solvent of the light hydrocarbons. The mixture when ready for application shall have a gravity of from seventeen to thirty, Baume, at seventy-seven degrees Fahrenheit. In all cases this binder shall be

sufficiently fluid to carry the bitumen into the pores of the concrete before the solvent body evaporates, and to leave a coating of bitumen on the concrete surface upon evaporation. The binder shall be applied either hot or cold, by an approved pressure distributor, as may be required, at the rate of one-eighth gallon per square yard.

WEARING SURFACE

After the solvent has evaporated from the binder, the wearing surface not exceeding one-fourth inch in thickness after compression shall be spread. The wearing surface shall consist of rock asphalt or its equivalent, especially prepared, one-fourth inch crushed stone and Unionite asphaltic cement in the proportions of forty-seven and one-half per cent. of rock asphalt or its equivalent, two and one-half per cent. of Unionite asphaltic cement and fifty per cent. of one-fourth inch crushed stone previously coated with Unionite asphaltic cement. The Unionite asphaltic cement shall at all times be in such proportions as to make the wearing surface self-healing.

ASPHALTIC CEMENT

The Unionite asphaltic cement shall consist of equal parts of Benzol. Twenty-eight and five-tenths to thirty gravity, and asphaltic cement having a penetration of fifty-five to sixty-five at a temperature of 77 degrees Fahrenheit, and complying with the northeast boulevard specifications of the Buerau of Highways of the city of Philadelphia, dissolved together, either cold or heated to from 190 to 230 degrees Fahrenheit, after which the solvent shall be evaporated.

STONE

The crushed stone shall be clean, hard, trap rock with a coefficient of wear of not less than fifteen, or limestone with a coefficient of wear of not less than ten, which will pass a one-half inch screen and be retained on a Number 10 screen.

PREPARATION

In preparing the wearing surface, the rock asphalt or equivalent material and the Unionite asphaltic cement in the proper proportions shall be first mixed either by being heated together or mixed cold. The crushed stone, which shall be heated or dried to a temperature not exceeding 300 degrees Fahrenheit, and then thoroughly coated with Unionite asphaltic cement in a cement mixer approved by the Chief of the Buerau of Highways, shall then be thoroughly mixed in equal proportions with the rock asphalt or its equivalent, and the Unionite asphaltic cement previously mixed until the mixture is uniform throughout.

PLACING

The material shall not be dumped directly on the concrete base, but shall be dumped on a suitable dumping board and then spread on the prepared concrete base by suitable means to the required thickness, and immediately compressed by a steam roller weighing not less than eight tons nor more than ten tons. The rolling shall be continued until the resulting wearing surface is thoroughly compressed, after which a thin layer of trap rock chips passing a three-eighths inch screen, free from dust, thoroughly coated with asphaltic cement before application, shall be spread upon the surface and then rolled. The wearing surface is to be laid at a temperature of from 225 to 300 degrees Fahrenheit.

The detailed costs of each method of construction and treatment on each of the individual sections of this service test roadway are interesting, and will, without question, prove of great value to highway engineers and street officials throughout the entire country as a guide. But they will be all the more valuable, year after year, as the pavement increases in age and reports are made on the condition of the various surfaces of these sections. The details and unit costs of construction on each of the five sections, as well as schedules of wages, temperature at which the construction proceeded, traffic census, etc., were as follows:

SECTION NUMBER 1

Station 0+00 to 22+50.

*Composition of the Concrete.* The concrete in this section was composed of one part cement, two parts sand, and three parts gravel passing a one and one-half inch ring and retained on a one-quarter inch screen.

*Expansion Joints.* Steel joints were used from Station 0+30 to Station 5+40, and bituminous joints from Station 5+40 to Station 22+50.

*Treatment of Surface.* From Station 0+00 to 10+50 was untreated; from Station 10+50 to Station 13+50 was treated with Tarvia; from Station 13+50 to Station 16+50 was treated with Ugite; from Station 16+50 to Station 19+50 was treated with asphalt cut-back, and Station 19+50 to Station 22+50 was treated with Unionite.

*Cost Per Square Yard.* The cost per square yard was as follows:

| | |
|---|---|
| Preparation of subgrade | $0.0878 |
| Concrete pavement | 1.0085 |
| Shoulders | 0.0323 |
| Total | $1.1286 |

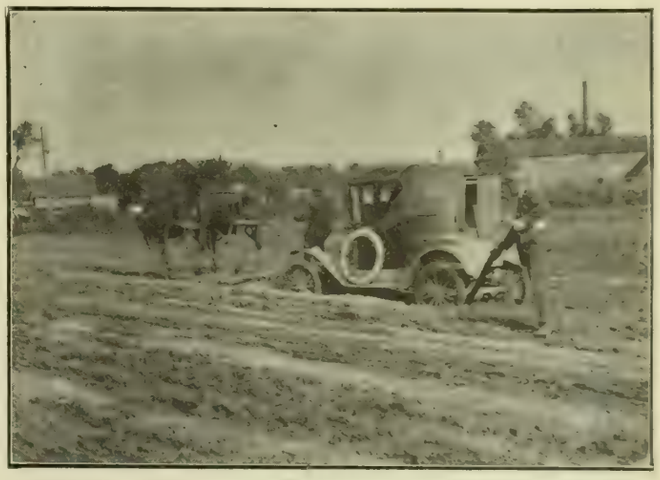
*(To be concluded in September)*

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## Model Good Roads Day at Spencerville, Ohio

### By G. F. Rudisill, State Director Ohio Good Roads Federation

"Rain can't keep a good community down, but bad roads can," is the slogan of the people of Spencerville, Ohio, and a few weeks ago they suited the action to the word, with the result that every road leading out of that thriving, wide-awake village is a good one. There are hundreds of communities in Ohio and the nation whose efforts for community betterment have attracted attention and caused much favorable comment, but who has not heard of Spencerville since her "Model Good Roads Day," held on June 14, 1916.



**One of the Excuses for a Good Roads Day**

Spencerville is located in Allen County, Ohio, but the Spencerville community, as such, embraces portions of several counties—western Allen, northwestern Auglaize, northeastern Mercer, and southeastern Van Wert—a community whose chief assets are: fertile fields, thriving farmers, public-spirited business men, paved streets, good roads in two directions, an abundance of civic life and local pride; and last but not least, an organized community sentiment, country, and village cooperating as one, presenting an object lesson in solving civic problems. Such elements will make for the progress and influence of any community. In her list of liabilities, the Spencerville community had some bad roads, which needed early and effective treatment.

Of the one thousand miles of roads in Allen County more than three-fourths have been improved of different characters of construction, there being but two hundred and seventy miles of unimproved road in the county. The county, not unlike many other counties of the State, is now face to face with the problem of repair and maintenance; in fact the county presents several examples of roads sadly in need of repair. This condition exists, not necessarily because of lack of funds, but because of—well, that's another matter. Politics? That's what they say, some on the part of a few of the officials and a

little in some of the criticism made of them. But that is nothing unusual, as mud and politics have been factors in our local road problems for years.

Doubtless there are many good things in store for Allen County for the reason that her people are waking up to the necessity of systematic road improvement on a business-like basis. Again, the different townships, inspired by the efforts




**Group Showing Director, Captain, Engineers and Committee in Charge**

of Spencerville, are considering the desirability of observing a county-wide good roads day. Such a proposition is now before the State Good Roads Committee of Allen County, branch of the Ohio Good Roads Federation. This committee is made up of some of the biggest men of the county and is headed by S. M. Williams, Lima, whose influence as a good roads advocate has been felt in the road movement of every State in the Union.

During the past several years a number of communities of the State have conducted Good Roads Days in an effort to reshape and repair their roadways, and following some of these occasions the Ohio Good Roads Federation has investigated into the character of the work that was carried on and determined the actual good that was done the roadways. While in some cases the work done was necessary and results were satisfactory, in a great many instances it was found harm had actually been done the roads and after the first rain they were in worse condition than before. In order to assist the communities of the State in conducting this kind of work and that

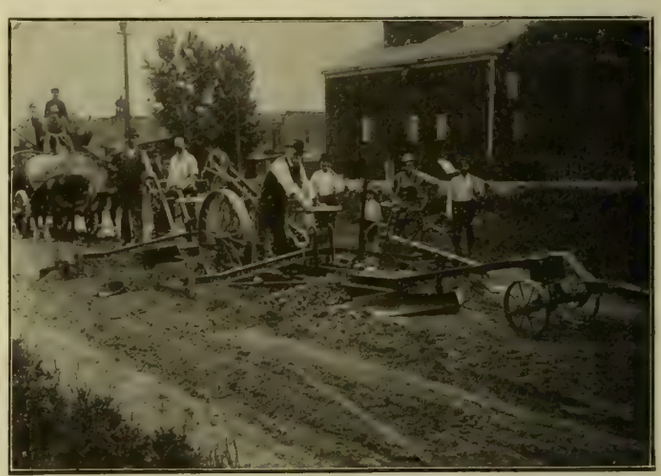


**Tractors and Trailers Hauling Stone**

the greatest possible good may come from such effort, the Federation undertook to put on a demonstration at Spencerville to show what can be done with careful planning and skilled supervision. A model plan was devised by the Federation, and it was taken hold of by the committee at Spencerville in a way that meant success for the venture.

Briefly stated, the model plan is made up of a captain and eight departments, to be composed of men who will give their best effort to the project. Provision is made for securing a competent road engineer or builder to go over all the roads which need attention and divide the mileage into divisions, as well as make an estimate as to the number of men, implements, tools, and amount and kinds of material necessary for the work in each division. This report or estimate is placed in the hands of a supervision committee of which the captain is chairman which committee divides the duties of securing the volunteer labor, material, implements, etc., among the different committees. As the work progresses the sub-committees report promptly and often to the supervision committee in order that no detail is neglected. The plan further provides that upon the day set for Good Roads Day each gang is designated to a division and an engineer or competent road man is placed in charge. The program of things to be done, as previously prepared, is placed in the hands of the engineer and he goes upon the roads in his division and supervises the work, all materials, machinery, tools, etc., having been placed at designated points for his use.

Sufficient to say, the plan worked admirably, and when the sun had set on the evening of June 14, each of the seven roads leading out of Spencerville was a good one. In fact, a great deal more mileage was drained, crowned, repaired, or reconstructed than the committee set out to accomplish, because of the great interest manifested by the citizens and the large number that volunteered to "work the roads." The committee secured the sanction and support of the officials of the village and of a number of the townships and counties in that section, the county commissioners and county highway superintendent



**Road Planer Shaping Both Sides of Road at Same Time**

of Allen County giving every encouragement and effort to the project. During the day special praise was bestowed, and justly so, upon County Highway Superintendent, W. R. Toy, who had viewed all roads of the community as contemplated by the plan, and prepared the report of kind and character of work to be executed, prescribed the divisions and the number of men, kinds and quantity of machinery and materials needed for each division. He followed carefully every step in the plan and gave assistance and direction to the engineers on all divisions. The Captain of the Supervision Committee, Mr. Paul Cochran, saw to it that every subcommittee did its duty preliminary to and on the day set, with the result that everything was primed for action and from the time of the cannon salute of ten rounds at 5:30 a.m. until the close of the days' work at 5:30 p.m., there was not an idle moment. Farmers with their teams left their fields, merchants and bankers, lawyers, doctors, ministers, and citizens of every walk, left their stores and offices and places of work to give a day to the welfare of the community. The demonstration was under the direct charge of G. F. Rudisill, State Director of the Ohio Good Roads Federation, with headquarters in the lobby of the Citizens bank. A local photographer and the Mutual Weeklies camera man were present to secure the features of the day and to show the character and effectiveness of the work done, the film to be shown as an educational feature in the Mutual picture houses of United States and Canada.

Approximately five hundred men, a number of whom were road officials; one hundred and twenty teams, a large number of tractors, trailers, rollers, scarifiers, graders, harrows, drags,

plows, in fact, all kinds of road tools and implements were provided and donated for the promotion of the work. Several car loads of material were placed on the roads for repair and reconstruction; a great deal of mileage of old roads was scarified and re-rolled; miles of ditches were opened; culverts and bridges and outlets were cleared; earth and gravel roads were reshaped and rolled; grass and weeds were mowed from the berms of improved and unimproved highways; brush and rubbish were cleared away or burned. First honor for example of the best results was awarded to a division which had during the day transformed a rough, poorly drained road to a veritable boulevard, giving it proper, uniform ditches and crown and compacting well the center and berms with the use of roller. These are some of the results of the big, public effort at Spencerville.

The business men provided a fish supper at 6:30 and several thousand people were served, consuming nearly one thousand pounds of fish. Two brass bands supplied music for the concert at night, during which five good roads balloons were



Road Roller Pulling a Road Grader

sent up, announcing the close of a full day of work and festivity.

Quite a number of committees, delegations, and volunteer workers from neighboring communities and counties were present at the demonstration for the purpose of getting ideas and suggestions and to determine the value of the work done in order that they may make effort to bring up their roadways under a similar plan. A large number of letters has since been received by the Spencerville committee and the Ohio Good Roads Federation from over the country asking for the "Story of Spencerville," and seeking information as to the plan followed and the results accomplished. It might be said that if the model plan, or a plan whose purposes are the same, would be carried out by other communities where the roadways are badly in need of repair and road officials through lack of funds or otherwise are unable to remedy the condition promptly, they can do as Spencerville has done.

* * *

## The Legal Status of Highway Boundaries and Disposal of Surface Waters

GENTLEMEN:

*Introduction.* The subject upon which I am to address you this evening is quite unlike most of the subjects which you have had discussed in these lectures. It is not an exact science, and does not deal with material or corporeal matters.

Unfortunately, the law of boundaries on highways and the law of surface waters are not uniform in the several States nor are they very well settled in the different States.

*Contribution of Professional Work.* When I was an engineer and in the practise of *the* profession, the professional eye was focused upon branches of engineering that involved stresses, strains, pressures, and the application of mathematics and physics to engineering. General municipal work, such as highway construction, had not gained the recognition of engineering operation, though it was the longest practised. Highway, municipal, sanitary, hydraulic, and dynamic engineering were not designated as engineering branches, but were all included in the general term of civil engineering. The modern profession now furnishes combinations such as those of geology or mineralogy in highway engineering, and recently the combination of chemistry and physics in chemical engineering, and in my own case that of law and engineering in engineering jurisprudence. There is to-day a great tendency to combine other professions or occupations with engineering, in specialties such as those mentioned, and going even further into medical or sanitary engineering, industrial efficiency, and sales engineering. These combinations undoubtedly give to the practitioner a broader view and greater capacity for undertaking the specialties which he follows.

*Pioneers in Highway Engineering.* One of the first to take up, scientifically, highway engineering was the Massachusetts commission, on which was Nathaniel S. Shaler, the eminent geologist. Professor Shaler was then Dean of the Lawrence Scientific School, the Harvard Engineering School, and he brought or sent to the commission graduates of the Harvard Engineering School, who, under his advice and counsel, had pursued geology and mineralogy. These men are now among the foremost highway engineers of the country and they include such men as A. M. Johnson, A. B. Fletcher, Logan W. Page, and others, and their work is but an illustration of the value of the combination of two or three occupations or professions.

*Law and Engineering.* The combination of law and engineering is not new. As early as 1827, one attorney in England published a book entitled "Architectural Jurisprudence," but the word was obsolete until it was again employed by the speaker in 1897 as the title of a book. The subject of boundaries is an old one in law publications, but textbooks in the law have been largely superseded by the Encyclopedia of Law, which has supplemented the textbook.

A highway is in its ordinary acceptance a way maintained by the State or some governmental division for public travel, usually for vehicles propelled by man, animal, or some agency of power.

The constitution or laws of the State make it obligatory upon the State that it shall establish and maintain public ways, and it is a duty that the State and its subdivisions owe to the public. This duty requires not only that the highways should be established, but that they should be kept passable and in a fair state of repair for use, and this is an obligation which may not be neglected.

Highways once established must have location and certain limits as to length, breadth, and height, as well as limits to the uses and purposes for which they can be used.

The physical limits are called boundaries, which is part of my subject for this evening.

*Boundaries.* Boundaries on highways and elsewhere are usually established by persons or municipalities or the government, by descriptions, through the medium of language, usually written; boundaries, therefore, become a question largely of intention, as expressed or interpreted by the language employed.

When the intention is clear, it will prevail, the same as in other instruments, such as deed, wills, bills, or memoranda of sales, agency and assignment. The *intention* of the parties, both parties, is what will govern, if that intention be expressed clearly and so that both parties should have comprehended it.

*Law of Boundaries.* It is when the intention is not clearly expressed that the law asserts itself and applies its principles: giving to the parties the intent, motive and purpose of doing that which is most rational and best for public interests, the security of titles, and the avoidance of litigation and trouble. Such is the basis of our jurisprudence, namely, for the law to assert itself and give to the parties what the courts deem the best policy when they have failed to be precise and certain in the written declarations.

*Boundaries of Ways.* With respect to the description of property bounded by streets, roads, and ways, the policy of the law is to give the ways to the abutting owners, subject to the use of such ways for travel and street purposes. That seems to require that abutting owners should own to the center of the road or way.

Lecture delivered by John C. Wait, Attorney at Law, New York City, in the Graduate Course in Highway Engineering, at Columbia University ,February 28, 1916.

*Law of Public Policy.* The law that prevails with respect to boundaries of roads and ways does not exist solely because the abutting owner ever did own to the center of the street, but it is based upon public policy. All American and English courts recognize the existence of a rule or presumption that a conveyance of land bounded on or by a highway passes to the grantee a title to the center of the way. The difference in the opinions by the courts arises from the application of the general rule. The rule is founded upon a policy which tends to guard against inconveniences of the most alarming character. If such a rule were not adopted, confusion would arise and titles would not be secure.

*Reason for Rule.* The chief reasons for holding that abutting owners shall own to the center of the street or stream, canal, or way are the following:

(1) To prevent the existence of innumerable strips or gores of land along the margin or in the beds of streams and highways, the title to which might remain in abeyance for generations, after which, upon the happening of some unexpected event, abutting owners would find themselves harassed with litigation, and would find themselves without the means of entrance and egress from their properties, and surrounded by embarrassments which would result.

(2) The abutting owner pays the taxes and is usually assessed for the improvements of the roads and streets, such as paving, curbing, sewers, and it would be an injustice that some one else should reap the benefit of such expenditures.

(3) The abutting owner is held responsible for the conditions of the street, such as clearing the walks of snow and all other obstructions.

(4) The ordinances, statutes, and courts universally hold abutting owners responsible for all burdens and improvements to his half of the street, which is a good and sound reason why he should have the proprietary interest in it.

*Effect of Contrary Rule.* Any contrary rule would introduce a flood of unprofitable litigation to abutting owners, unless indeed all roads and highways should be taken over by the State, which would have exclusive ownership in them, but would the State assume the burden of all the improvements necessary to be made in streets, would the State get the requisite benefit from a sidewalk in front of an abutting owner, that it would be willing to pay for such an improvement? Until the State will assume such burdens or assume to provide ways and means for assessment of public improvements against the properties benefited, it would seem that public policy would require that the laws should remain as they are and that abutting owners should own to the center of the ways.

*Application of Rule.* With this presumption in mind, and land bounded by the words "on," "by," "along," or "upon" a public way or road, extends to the center of the way, unless there are words in the description to show contrary intent, and the description must be clear and unequivocal that it was the intention of the grantor to limit the landowner to the edge or side of the street. When land is described as lying on a street or along the street, or by the street, or by said road, or when city lots have been described as abutting on a street and designated by numbers, in each instance the courts have ruled that the description extended to the center of the street or way.

*Side of Street.* If a description goes to the side of the street, or along the side of the street, or to the side of the street and along the street, it limits the land to the side of the street and excludes the highway. The law applicable to this description, however, has not been universal, and in Pennsylvania it has been held that even under this description the owner took to the center of the street or way.

*Maps and Lot Numbers.* Streets that are dedicated to the public by landed proprietors, who divide their property up into lots and sell the same by maps, upon which streets are delineated and shown, and who sell them by numbers of lots or as a certain number of feet fronting or abutting upon a street, are usually held to have conveyed with the lot the land in front and to the center of the street. This rule is not universal, however, and may vary in different States.

*Rule on Streams.* The rule that where land is described upon a natural stream as going to a stream and along the stream, the estate conveyed follows the stream wherever it goes, does not prevail generally in boundaries upon streets, roads, and ways, for in the one case the movement of the stream is guided by nature, while in the other the change in the location of the street is usually an act of the municipality, county, or State, and property rights may not be changed by the act of persons with the same effect that they are by the act of God.

*Abandoned Streets.* After what has been said as to the ownership of abutting owners in streets and ways, it would naturally follow that when streets are abandoned, or even ways such as railways and canals, the land would revert to the abutting owners, and each would take to the middle of the way. This rule prevails generally throughout the States, and when canals or roads are abandoned by the State or by the municipality, and the rights of the public to travel over such ways ends, then, of course, the property with all its rights reverts to the owners thereof.

*Property in Ways.* A proper understanding of boundaries on highways, or surface waters in connection with them, can be had only by a clear comprehension of the rights, title, and interest of abutting owners and the public or the State or county in such highways. Throughout the New England and Middle States, the ownership of highways and roads is almost universally in the abutting owners, and the public, the State, or the county enjoy only an easement of travel or right of way over such lands. The soil, any minerals, water, oil, or gas, all trees and vegatation that abound in or upon said land, belong to the abutting owners, together with the fruit, vegetables or seeds that may grow upon them. Some cases have gone so far as to grant abutting owners the right to remove people from occupying a roadway or highway for other purposes than that of travel, as for sight-seeing purposes, for purposes of trade or observation.

*Road Materials.* This question of the ownership of highways frequently arises with the State Department of Highways when materials, as gravel and sand, are taken from banks in the highway for repairs or construction purposes at other points than where taken from. Abutting owners have been known to come forward with their teams and to forbid the State or its contractors taking such gravel, sand, or rock, and to themselves load their wagons and to appropriate such materials to their own individual purposes. Generally speaking, where the public or the State or county has only an easement of travel or right of way, the abutting owner may prevent the removal of such materials or may take them himself to his own uses and purposes, whether for filling or otherwise, and the State may not appropriate them for repairs to other portions of the driveway or road. In some States and jurisdictions this has been permitted and held to be lawful, and in others it has been forbidden, where abutting property-owners have objected or protested.

*Instance.* An instance came to my attention not long ago in Long Island, where a farmer objected and protested against the State drawing gravel and sand from a hill where it was making a cut, and using the same for surfacing other parts of the roadway. The State, by its supervisor and engineer, proceeded to appropriate his sand and gravel, and the abutting owner immediately put his own team to work and called upon his neighbors with their teams to haul the sand and gravel to an intended site of a new house. Several hundred loads were drawn and dumped round about the proposed building, and the farmer, when he had taken all that he thought he could use, was satisfied. It is now some five years since, and the sand and gravel still lie there, covering half an acre, more or less, of arable land, which is now grown up to weeds and as unsightly as can be. It may be fifteen years or more before that sand and gravel will be used, depending upon the finances and the spirit of the farmer. However, it is assumed that it looks good to the farmer, and that the State is likewise very well satisfied.

*Toleration.* The State of New York pursues a policy of toleration towards abutting owners. Generally, our farmers appreciate the benefit of good roads, if made for general vehicular traffic. In automobile roads, however, they often take an adverse interest and are ugly. When in such a state of unhappiness, they assert their rights, and with hay-forks, pick-axes, dogs, and women folks, constitute a formidable force in such assertion. If left to their own way, however, they become reconciled with nothing to fight about, and become valuable co-operatives in good road-work.

*Highway Specifications.* In the preparation of specifications, the highway engineer may not, in the name of the State or county, give to the contractor the use of gravel and sand from the roadbed, nor authorize the contractor to appropriate such materials. Abutting owners may prevent such acts in many States and jurisdictions. It is usually wiser to state in the advertisement or invitation to bidders that appropriate and suitable materials are to be had along the line of the work, but that the contractor must make his own arrangements for the purchase from abutting or nearby owners of their materials of construction, and that the State assumes no liability in the matter.

*Value of Materials.* Probably nobody appreciates better the ownership of good sand, gravel, clay, stone, and even water than the average farmer. In Long Island, road builders found themselves required to pipe water sometimes for distances of two to three miles, for mixing concrete for roadbeds, and knowing that, you will appreciate the value of even surface waters when collected in low, shallow places along the line of construction work. Neither the engineer in the preparation of his contract and specifications, nor the contractor in making his estimate, may assume that he has the unqualified right to appropriate such surface waters. The person who owns the land upon which they are imponded may know the value of them to the contractor and set a proportionate price upon them.

In preparing specifications for road building, the most material factor is the use of the materials at hand. Yet frequently the government may not avail itself of the materials of construction found within the roadbed or right of way. This situation is going to have considerable bearing upon the future of our country and in the problem of preparedness or defense, for good roads and ways are the most vital element of modern warfare. If the State cannot control, dispose of or even own the materials that occupy the roadway, it is high time that thoroughfares were established throughout the country by the condemnation of lands over which they pass and the exclusive ownership of such thoroughfares by the State or the Federal Government.

*Uses of Highway Restricted.* In the present situation, where the abutting owner and usually a farmer owns the right of way, it is doubtful even if the use of the right of way for contractor's plant and material is within the easement owned by the public. And the subject of the ownership of streets and roads is closely identified with the obstruction, interference with travel and the rights of way over roads and highways.

*Husbandry in Road.* With the ownership of the land in the abutting owner goes the right to pasturage of cattle, swine, and other domestic stock; also the plowing and planting of such rights of way, not used for travel, for potatoes, corn, and other crops. While this is not usual, for the reason that the farmer's crops would doubtless suffer from the public employing the road for travel and for driving droves of stock, horses, cattle, sheep, etc., which would trample down the potatoes, eat up or destroy the corn and other crops, yet if the abutting farmer cares to assume that risk and his cultivation of part of the right of way does not interfere with travel, he undoubtedly may do so.

It is a prevailing custom in some parts of the State to plant apple trees along the roads, and to gather the hay crop and to pasture the horses in the roadway, and these acts, while they may appear ordinarily to the layman or even to the engineer as acts of lawlessness, are on the contrary acts strictly within the rights of abutting owners.

*Good Roads Appreciated.* It is gratifying to state that with the intellectual growth of our country the farmers and country folk are becoming more enlightened and more appreciative of the efforts of the State to do for them and to improve their condition. This is apparent to them when the State collects from motor vehicles a million or more dollars per year for road improvement, when it taxes roadhouses and saloons to the extent of millions of dollars, portions of which are devoted to road and canal building, and when these legislative acts and laws reduce the taxation of the farmers to a fraction of a cent on the dollar. Such laws would cultivate the friendship, intelligence, and enlightment of any class of men.

*Boundaries Established.* Boundaries may be established by other means than by deeds or wills or by the property-owner's own voluntary act; as, by the legislature, by court proceedings, by arbitration, or by acquiescence or lang usage.

When the legislature or court fixes boundaries, they are more likely to be definite and certain than when described by individuals. If they are not, then the same rules of construction are applied to them by the courts as in the case of individuals; except, however, that the court will protect the interest of the State as against the individual.

*Arbitration.* Disputes as to boundaries may be submitted to arbitration and the parties bound by an award, the same as in other controversies. In such a case the courts would be bound to sustain such an award.

*Adverse User.* Boundaries may be also fixed and determined by adverse user or prescription. If the public or a party *use* a piece of land or a way over or through land in a certain way or for certain purposes, they will, after long usage (usually twenty-one years), acquire a right to continue to use the land or way, in spite of the owner's objections. Such rights are termed adverse or prescriptive rights. In such cases the boundaries are restricted to the land actually occupied or used, for the full period, usually twenty-one years.

*User Adverse the State.* Adverse use or possession cannot be had against the State or government; so that persons and the public cannot deprive the State from asserting at any time its rights in property, unless by special act of legislature such rights are given to the public or to abutting land-owners.

*Conflict of Calls in Descriptions.* When there is conflict in the calls of a description, the same rules apply as to boundaries between adjacent owners. One general rule is that the most certain and definite call or description shall prevail, as best showing the intention of the parties. Thus, a permanent monument would prevail over courses and distances; and the course is held to govern the distance, though why it should is not clear; and courses and distances control acreage.

### SURFACE WATERS

*Defined.* Surface waters have been defined as waters on the surface of the ground which are of a casual or vagrant character, following no definite course and having no substantial or permanent existence, and which are lost by being diffused over the surface of the ground, through it by percolation into the soil or from it by evaporation.

*Distinguished.* They are distinguished from watercourses, which flow in definite channels, and from lakes and ponds, which have a substantial, as distinguished from a vagrant existence. When surface waters enter a stream or permanent lake or pond, they lose their character as surface waters, and the rights of persons in their use or diversion are governed then by the law of watercourses and of lakes and ponds. Flood waters caused by the overflowing of the banks of watercourses are usually treated as surface waters until they return to the stream when the water subsides.

*In Highways.* Surface waters are among the problems which the highway engineer must consider at every stage in the design, construction and maintenance of a highway. Sudden melting of heavy snows, or sudden and heavy rainfalls, create good-sized streams in highways if they are not diverted by frequent water bars or by culverts and drains; and it often becomes a problem for the highway engineer to determine how best to dispose of the accumulation of surface waters with which he has to deal.

*Application of Laws.* The law on the subject is very meager as applied strictly to highways. There are many decisions with respect to railroad embankments and the diversion and obstruction of surface water by railroads, but very little upon the subject of highways. The meagerness of decisions in State, county, and town roads, is largely due to the fact that generally the abutting owner owns also to the center of the roads.

The books are replete with decisions with respect to adjoining property-owners, the diversion and obstructions of surface waters with respect to one another, and the law with respect to highways will have to be worked out from the general law applicable to adjoining owners, for abutting owners may be regarded as adjoining owners to the State or county or municipality which maintains the highway.

*Civil and Common Law.* The law applicable to surface waters is not general throughout the United States, but is considerably different in the several States and in adjoining States.

and two rules have been adopted, one known as the rule of the *civil law* and the other the rule of the *common law*, and some States have adopted a modified doctrine which embodies essential principles of both rules.

The Southern States and some of the Middle States have adopted the civil law rule, which is, generally speaking, the right of the owner of the superior or higher lands to drainage upon the lower lands, this being based upon the natural law of water to seek its own level; and the reason for its adoption is that a rule which natural rules enforce is unquestionably and clearly the better and more equitable law, because there can be no surprises or hardships in this, for each successive owner takes his land with whatever advantages or inconveniences nature has stamped upon it.

*Civil Law.* Under the civil law, therefore, a servient owner of lands at a lower level could not obstruct the flow of waters from land at a higher level, and if the servient owner desires to improve his land, he must make provision by drains or otherwise for the discharge of natural flow of surface waters from the higher or upper lands, and he must do this or obstruct them at his peril.

*Common Law.* Under the common law rule, which prevails in the Northern and Eastern States and in some of the Western States, a servient landowner has the right to take any measures necessary to the protection of his property even though he prevents the entrance upon his land of waters which naturally flow there, and if damages result to the upland owner they afford no cause of action. The servient owner may build walls, embankments, and dams, and protect his property by levees or otherwise from the overflow from his neighbor, under the common law rule, though he may not do so by trespassing upon the land of his neighbor.

That the common law rule prevails in the most thickly settled States and in those having the larger number of cities would seem to indicate that the common law rule had grown up from necessity, resulting from the improvement of land in thickly populated districts like cities, where every available square yard was utilized. Any one would appreciate that a person who purchased a city lot would be justified in erecting the walls of his building without regard to his near neighbor or what happened to him with respect to surface or underground waters, and the courts would appreciate the necessities in the cities, where sewers and drains are constructed, of requiring an adjoining lot-owner to take care of his own surface water and sewage. Whereas in the Southern States and in the Western or prairie States, and where argiculture predominates, one can appreciate the damage done to a neighbor if a landowner were permitted to build dams and set back surface waters, especially in the great, broad, and flat areas of the prairie States and of the Mississippi Delta, where a dam or levee of four or six feet in height might flood thousands of acres of arable land.

*Compromise Laws.* In other States, and particularly New Hampshire, where large mill rights are at stake, we find a modified rule, by which the lower landowner may obstruct the flow of waters upon his premises while in the reasonable use and improvement of his land, but the lower landowner may not make an unreasonable use or improvement of his land and obstruct the flow of surface waters over it to the injury of his neighbor; and the question of reasonableness is usually one for a jury to determine upon the facts presented. The United States courts usually follow the decisions of the local State courts in the application of these rules.

In the application of these rules, it would be generally necessary to make a study of the law and the decisions of any State in which you may be employed as engineers, but generally the State of New York has adopted the common law rule.

*Care of Waters.* The care, diversion, or obstruction of surface waters in the construction and maintenance of highways, as stated before, is a serious problem. It is not always convenient to divert the waters from a highway at their natural point. If so diverted, they frequently will require ditches or drains upon adjoining property, which cannot be built except with the consent of the adjoining owner or by condemnation proceedings; or, if such ditches or drains be not provided, the waters may be deflected back into the road at some lower point. If a road be upon a side hill, surface waters will accumulate on the upper side of the road, and after being conducted some distance must be carried either over or under the roadway to the lower side, and there be discharged in considerable quantity either into the gutter upon the south side or upon the abutting landowner. Waters so conducted and collected will in heavy storms be projected upon abutting land-owners in large quantities, and will ordinarily carry silt, sand, gravel, and stones of considerable size, piling and heaping up to the detriment of the abutting landowner and over considerable area, sometimes approaching a quarter-acre. Uusally such a diversion and projection of sand and silt upon an abutting landowner bring a protest and sometimes claims against the State or county. In sparsely settled counties, where land is not of much value, the question would not be material, but in localities where land is valuable, or where it is used for manufacturing, residential, or even gardening purposes, the trespass become, a serious one, and it is equally serious for the State to undertake to conduct waters for any considerable distance down a steep hill within the highway boundaries.

*Devices.* This problem was formerly met by placing frequent water bars across the roadway, known as "Thank you, ma 'ams," which afforded resting places for teams in going uphill or down, but which with modern automobile traffic provoke other exclamations than "Thank you ma 'am." The advent of the automobile and of high-speed vehicles has practically done away with the "Thank you, ma 'am," and the State has now to provide adequate gutter ditches and drainage for such distances along the highway as will reach an accommodating abutting landowner or some watercourse into which the water may be discharged. These conditions sometimes necessitate the construction of pipe drains and in some instances of brick culverts of considerable length and expense, for it is unquestionably the law that the State or county, in the construction of its highways, may not accumulate surface waters by gutters, ditches, trenches, or otherwise, and discharge the water in a body upon abutting owners, to their damage and detriment, any more than the owner himself may collect quantities of water in trenches or drains and discharge it into the highway to its detriment and destruction.

*Discharge Waters.* As to what would be an unreasonable discharge of water in either direction would depend probably upon the results or consequences. If the water were dissipated over a considerable area, so as to flow away in the bushes or grass, and without casting debris upon the abutting owner, thus minimizing the damages which he might suffer, it would probably be within the province of the highway engineer to so divert surface waters, and the liability of the State or county for such acts would depend largely upon the injury or damage that resulted.

*Personal Liability.* The personal liability of a public official, as a highway superintendent or commissioner, for such diversion would depend upon whether he acted in good faith and as a prudent man in the discharge of his duties. If it were done outside of his duties and in a reckless manner, his liability might be established.

*Ownership of Abutters.* In connection with the diversion or casting of waters into the highway by an abutting landowner, it should be remembered that the land of the ordinary and usual highway, outside of municipalities, belongs to the abutting owner, and that the State, county, or public have only the right of travel in it, and those rights which are necessary to maintain the highway and to make it safe for travel. It would, therefore, follow that an abutting landowner would be given every privilege and permission in the use of an abutting highway that he would have in his own land, so long as it did not interfere with public travel and the public uses of the highway for travel. Originally, the uses of highway were solely those of travel, but by statute and by judicial legislation highways have in many instances been burdened by other uses, such as drains, requisite and necessary to properly carry off the waters from the highway; also in some instances telegraph and telephone poles, sewers, and even waterpipes. These later uses, however, have been largely confined to villages and cities, where the comforts and conveniences and protection of its inhabitants would seem to require a household supply of water, gas, electricity, and electric communication, and likewise sewers to carry away the wastes.

*Railways.* Highways erected by the State would no doubt be governed largely by the same law that is applicable to rail-

road companies in the building of their railroad beds and embankments. It has been held that a railroad company may not construct its roadbeds so as to collect surface water in ditches, where the natural flow is intercepted by their embankments, and precipitate such waters in increased volumes upon adjoining landowners; that such companies are required to construct their embankments so as to resist the pressure of surface waters which accumulate against them, for if they do not withstand the pressure, and by giving away flood the landowner, the railroad company would be liable.

*Natural Damage.* Surface waters may, of course, be drained into natural or even artificial water-courses, if the artificial watercourses are conducted to natural ones, as watercourses are outlets provided by nature for carrying off such waters, and the law pertaining to watercourses forbids their obstructing, damming, or interference with to the detriment of abutting or neighboring landowners. Generally speaking, the drainage of highways is governed by the same rules as farm drainage, and surface waters of such highways can be collected and discharged into watercourses even though the volume of said watercourses is greatly increased.

*Licenses.* A highway commissioner, on behalf of the State, may, of course, secure by contract the right to divert the natural flow of surface waters upon land and to discharge them upon or over the land of abutting owners, or to maintain artificial drains over such lands. In making such contracts or agreements with farmers, the engineer or commissioner should be careful not to obligate the State by contract to the maintenance and repair of such drains or to make them liable for the damming or obstruction of such drains or ditches. A contract which would bind the State would ordinarily be required to be made by some higher official than engineer in charge of construction, or even a highway commissioner, unless he were given authority expressly by statute. (New York State Highway Law, Secs.)

*Condemnation.* If such an agreement cannot be made with the abutting owner, provision is then usually made by which the commissioner of highways, or some other designated county or State official, may proceed to condemn a right over lands for such a drain or ditch.

*Filling.* Low places, as in marshes or ponds or covered with surface water, may be filled in and raised by a commissioner or engineer in the same manner that any adjoining owner may fill in low places of his land and make it arable or useful. No complaint or action for injuries or damages may be had by adjoining or abutting owners by reason of the increase in depth of surface water over their lands, for the State or county may improve its land for the purposes of a highway, as for travel, as landowners may improve their premises for farming or manufacturing purposes.

*Damages from Waters.* There are several conditions that arise from surface water which may prove a source of injury and damage, resulting in claims against the person who directs, diverts, and discharges the surface waters in an unlawful manner. These are known as obstruction, diversion, repulsion, discharge, impounding, polluting, and fouling of waters. There is the direct discharge of waters against the property or land of another, the setting back of waters and consequent overflow of lands and structures, the impounding of waters by damming, as by embankments, and the sudden escape of those waters by washouts or the failure of the embankment; then there is the withdrawal and appropriation of surface waters, which the lower owner may be entitled to have flow in their natural course.

*Assessing Damages.* In presenting claims for damages from the diversion, discharge, repulsion, or pollution of waters, numerous difficulties arise. Usually the injuries and damages do not result from the acts of any one person or party. If floods occur and the waters are set back, if they are obstructed and let loose in volume, if they are diverted against a neighbor, frequently it is not the act of one person, but of several, and it is next to impossible to determine how much the several structures or embankments contributed to the injury, or how much damage is assessable against each one of the several who contributed to it. In the case of pollution of waters the fouling of waters may be contributed to by several neighbors or manufacturers farther up-stream. This brings up questions of joint tort feasors or joint wrong-doers, how they are each severally or all jointly liable, when and under what circumstances they are joint tort feasors, and many other questions too numerous to mention.

(Illustrated by Western Cartridge Co. v. Big Four R. R.)

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## The Determination of Justifiable Cost in Highway Construction

### By Edw. St. C. Smith, Former State Highway Engineer of Idaho

THE selection of the best and most economical type of road to build in any particular case involves the consideration of a number of conditions affecting such a determination.

The term economical is here used in its broadest sense and is not to be interpreted as meaning cheap or low first cost. The road of low first cost very often proves to be the most expensive in the long run because important principles were sacrificed in the original construction for reasons of so-called economy.

"The greatest enemy of good road construction is the desire to get something at a price inadequate to meet the conditions imposed. Any expenditure is justifiable which is necessary to meet such conditions and give satisfaction. It is economy in the end."

Since the conditions in different localities vary so greatly, there is no hard-and-fast rule to be applied in answering the question, "What kind of a road shall we build?" Each case must be considered upon its own merits. Nevertheless, there are certain economic principles which can be applied to the design and construction of roads of all classes.

The following features may be said to govern the justifiable cost of any highway: (a) traffic requirements, that is, volume, weight, and kind of traffic; (b) amount of money available for construction and maintenance.

Since any road is a failure which does not carry the traffic for which it was designed, the justifiable expenditure should be that which will produce satisfactory results under the service to which the road will be subjected.

The cost must not be regarded merely from the viewpoint of first cost, but of first cost plus maintenance during the life of the road. The cost of initial construction is not the total cost of a highway. The prevailing opinion seems to be that, once built, a road is good for all time. No greater fallacy could be imagined. No road is ever completed in that sense, because it is at all times subject to the breaking-down process of traffic wear and the deteriorating effects of the elements. Care and maintenance of a road must begin the day construction ends and be religiously continued during the life of the road. Only in this way can the investment be preserved to the community. The maintenance then becomes a fixed charge which must be taken into account and provided for and therefore constitutes a part of the ultimate cost.

Generally speaking, the answer to the question of justifiable cost is, "Pay enough to obtain a road which experience has demonstrated will meet the requirements of the present and future traffic at a reasonable cost of upkeep." If there is not sufficient money on hand to do this, put the amount available into such vital features as proper location, drainage, and subgrade. These constitute the foundation upon which every good road must be supported and are the only truly permanent features. Build upon this foundation as fast as means will permit, but build the foundation first.

In selecting any type of pavement, "service tests of roads subjected to similar conditions are the best criterion for guidance." We should study those road surfaces which have given the most satisfactory results and the most adequate return for the money expended upon them, and imitate the principles employed in their construction. Tried-out forms of construction and materials used therein are therefore the best evidence of how a road should be built in the future. The experience of the older States along this line is particularly valuable and we should profit thereby. It would be an indefensible policy to repeat the mistakes or fail to imitate the successes of other communities where road building has had its evolution from the experimental stage.

The main features to be considered in the selection of any type of road surface are:

Traffic requirements, present and future.

Availability of suitable materials.
Permanence.
Ease of maintenance.
Cost—first cost and maintenance.

A mistake often made is the designing of a road to take care of the traffic requirements of the present only, with no regard for that of the future. A road which is satisfactory for present-day needs might be totally inadequate for the requirements a few years hence. This is particularly true of motor traffic. Also the fact that an improved road attracts increased travel must not be overlooked.

A road should be so located and constructed as to be capable of permitting future surface improvement for increased duty without sacrificing any of the original construction.

*Materials.* The cost of any type of surfaced road depends largely upon the availability of the materials required in its construction. A good road cannot be built with inferior materials. Accurate knowledge of the properties of the materials used, together with information and data in regard to experimental and practical usage, is essential. If all of these factors are not properly considered, results will be uncertain. Many failures and large waste of public money can be charged to the element of experimental chance and lack of accurate knowledge. Highways built with borrowed money impose a grave responsibility upon the builders whose duty should be to so build that the results of their work will not become an unjust burden upon the next generation.

*Permanence.* Strictly speaking, no road surface is permanent. The so-called permanent types of roads simply approach that state more or less closely, and their degree of permanence depends upon how well they are maintained. The ideal surface is the one which requires the least maintenance. The aim should be to build this kind of a road consistent with the money available. As heretofore stated, the truly permanent features of any road are in the location, drainage, and subgrade, and the success of any kind of surface depends upon careful attention to these important principles which constitute the foundation.

*Ease of Maintenance.* This, while a very desirable feature of road planning, cannot govern the selection of a type because the easiest maintained pavements are usually the most expensive in first cost, representing an initial outlay and annual interest charge prohibitive to most communities. This fact, however, warrants expenditure of an amount sufficient to maintain in first-class condition a surface of lower first cost.

*Cost.* The most economical type of road is that for which the first cost, plus the cost of maintenance and interest on the investment for a given number of years, equals a minimum. The comparatively high construction cost of one type of road might be entirely offset at the end of ten or fifteen years by high maintenance cost of a cheaper type of road less permanent. On the other hand, more money could be justifiably spent for maintenance on the cheaper type of road. For example, let us assume that a bituminous macadam road can be built for $10,000 per mile, and suppose this to be paid for by twenty-year bonds at five per cent. The annual charge for interest on and redemption of the bonds would be about $800. Add $100 per mile per year for maintenance and we have the sum of $900 per mile per year as the cost of the road to the community. Now, we will assume that a first-class gravel road can be built for $2,500 per mile. The annual charge for interest on and redemption of twenty-year five-per-cent. bonds would amount to about $200 per mile. Therefore, it is theoretically economical to spend $700 per mile per year for the maintenance of the gravel road if for that sum the road can be maintained in a condition giving as good service as the $10,000 road.

"The secret of successful road construction lies in the proper design, proper construction, and the use of tried-out materials." The following points should be given careful attention: location, subgrade, drainage, and adequate foundation for surface. These may be regarded as permanent features of construction.

For surface treatment, a safe rule is, "Use materials and methods of construction demonstrated by previous experience and service tests to be satisfactory and to give an adequate return for the money."

There is one factor more than any other responsible for better road construction, and that is the automobile. Highway commissioners and highway engineers are often criticized for building so-called automobile roads, but such criticism is unwarranted. The automobile has come to stay, and it would be folly to ignore it by building roads for team traffic only. Furthermore, the time is almost here when the automobile will be just as much a part of the utility equipment of a farm as horse-drawn vehicles. The only increase in cost of roads that can be charged directly to the automobile is the top course or surfacing. The horse-drawn vehicle is still a governing factor in the determination of grades.

The State of New York has been building hard-surfaced roads for many years and has had ample opportunity to observe the advantages and disadvantages of each type. Such experience and service tests extending over a period of a number of years are very valuable to any community taking up this problem. The following data is taken from a recent article by Edwin Duffey, commissioner of highways, State of New York:

"Up until 1909, gravel and water-bound macadam, and in some few instances brick, roads were the only types of pavement considered.

| Year | Miles | Waterbound Macadam | Bituminous Macadam | Miscellaneous Types |
|---|---|---|---|---|
| 1911 | 943 | 19% | 75% | 6% |
| 1912 | 1422 | 25% | 45% | 30% |
| 1913 | 95 | | | |
| 1914 | 1152 | 35% | 32% | 33% |
| 1915 | 1066 | 50% | 33% | 17% |

The facts shown by the above table are very significant and are remarkable in view of the great change in traffic conditions during the period covered. Note the steady increase from nineteen to fifty per cent. in water-bound macadam construction when it was generally supposed that this type of pavement was a failure under motor traffic.

Commissioner Duffey further states: "These percentages will probably bear out the fact that, instead of the waterbound macadam being superseded by bituminous penetration road, it has a distinct place of its own and to our minds is the best type of pavement for moderate traffic roads in rural localities."

It should be noted that the type of road referred to by Mr. Duffey is not a true waterbound macadam, but a waterbound macadam with surface treatment to eliminate the dust and mud nuisance and disintegration of the top course. He says: "It has been found necessary to provide some sort of surface coat to prevent this preliminary wear and disintegration of the fine surface material. The use of calcium chloride for the first year is proving satisfactory in preventing the fine surface dust from being blown away or removed by automobiles." He states in conclusion: "Our present practice leads us to believe that waterbound macadam construction, including one treatment of calcium chloride in the contract, followed by bituminous surface application the following year, is a satisfactory type for moderate traffic on market roads.

A discussion of this subject would not be complete without touching upon the item of widths of roads for the reason that width affects very materially the cost of construction and maintenance.

The question of how wide a road should be built involves the consideration of several things, but is governed primarily by the amount and character of the traffic. We will consider here only the width of the pavement. Practice has demonstrated that the total width between ditches, or rather, including the ditches, should not be less than thirty feet, regardless of the width to be paved. Whether a single or double-track road is to be built, depends upon the traffic to be anticipated. Unless a pavement is twenty or twenty-four feet wide, the traffic will cling persistently to the center of the road. The only thing that will force it from there is more traffic. There are two reasons for this: first, too much crown on a narrow road; second, the tendency to follow a rut.

A road carrying heavy traffic should be wide enough and have a crown light enough to encourage traffic to use the entire width of pavement. Only in this way can the life of the surface be increased, the maintenance cost reduced, and the road operated to its highest efficiency. It should be borne in mind that while a double-track road costs proportionately more than a single-track road, the maintenance cost per mile of the former is much less for the same volume of traffic.

General practice seems to have adopted a width of nine or ten feet for single-track roads, and fifteen or sixteen feet for

double-track roads. Intermediate widths of twelve and fourteen feet have been tried out but experience seems to have shown that unless an *ample* double-track width is provided, a single track road had better be built, because only the liberal widths will be regarded as double-track roads and the traffic will stay in the middle. The extra three or four feet increase the cost from thirty-three to forty per cent., and are not used.

The narrow, so-called double-track roads would perhaps be sufficient for team traffic with some few exceptions, but for motor traffic they are invitations to disaster for automobile drivers who think they can pass at forty or fifty miles per hour, and sometimes they think wrong. Accidents of this kind are of almost daily occurence. Roads should not be designed to encourage speedy and reckless driving, but such things are inevitable and involve the lives of innocent people who must be protected. A road should either be wide enough to be safe for two vehicles or else be strictly a single-track road.

A possible solution of the problem where for financial reasons either single-track roads must be built or else the mileage cut down, would be to build the second or top course of macadam roads wider than the first course. In other words, extend the top course out over the earth shoulders for several feet on each side, using fine gravel or screenings. This outer strip is only used for passing. Its duty would be very light and it represents but a small percentage of the cost of the road.

No matter what type of road it is decided to build, the maximum possible expenditure is always limited by availability of the necessary funds, or in other words, the ability of the community to pay for it. The justifiable expenditure within such means is then limited only by the value of the road to the community as a profit-sharing investment, and that is the way it should be regarded, as an *investment,* from which the annual saving in lower maintenance charges, in reduced cost of transportation, the increased value of farm lands, the increased volume of taxable valuation through further development of the country by new settlement, and many other direct and indirect benefits which always result from good roads, will more than repay the annual cost of the improvement.

In most cases, the communities are now paying each year, as the cost of *bad roads,* more than would be required for interest on and retirement of a bond issue which would make possible a satisfactory system of good roads.

Strictly as an investment proposition based upon decreased cost of transportation, maintenance, and the saving in wear and tear on vehicles, the justifiable cost of an improved road is directly dependent upon the traffic, so that in planning a road system, the type of surface necessary for the main market roads would not be justified or necessary for the secondary roads or feeders, on account of the lighter traffic of the latter.

Whatever type of road is considered, the fact must not be overlooked that the cost of operation and maintenance is a continuing expense while the cost of construction is incurred but once; so that the type of road which costs the most to construct is not always the most expensive in the long run, nor is the one lowest in first cost always the cheapest in the end. "The road which is truly the most economical is the one which gives the most profitable returns for the money invested in it."

How, then, shall a community know which is the best and most economical type of road surface suitable for its particular needs and conditions when considering improvements of this kind?

In the first place, such information can be obtained only through a thorough investigation of all of the local conditions affecting the determination, such as: the volume and character of traffic both present and anticipated; the suitability of local construction materials; the limit of cost; etc.

These are matters to be investigated and determined by a competent highway engineer whose experience and observations are wide enough to render his report dependable and whose knowledge and familiarity with the characteristics of various types of pavements in actual service would insure his recommendations to be reliable. Several States have passed a law providing that before a bond election can be called, such information must be obtained by a competent highway engineer and submitted to the proper authorities. If the bonds are voted, the proceeds thereof must be expended under competent engineering supervision.

As a matter of good business procedure, it is assumed that no local board or commission would make a tax levy or call a bond election for road improvement without first having the above facts and figures before them for public information. As a corporation plans and builds a railroad, so should the representatives of a community plan and build a public work. It is a business proposition demanding good business management.

* * *

## A Friend of Man

By O. M. West, Tennessee Department of Highways

I am the road.
Over my silent form
The grinding wheels of traffic
Carry their heavy burdens.
I am the "Initial carrier."
I am the *Foundation*
Of all commerce.
On me rests the first burden
Of transportation.
The wool and the cotton for your clothes
Must first pass over my body.
The food man eats,
The forage for your armies
Must first be borne on my breast.
On me rests the first burden of man.
I am *Atlas.*
On my breast the barefoot boys and girls
Dance on their way to school,
On Sundays I carry the folk to church.
The lovesick lad and lassie
Make love on my breast but
I am a "Daisy" and "never tell."
The timber for the home
Must first pass my way.
I am the foundation
On which the government is builded,
On me rests the first cost of transportation.
I labor hard
To perform my duty to you,
Have you done your duty by me?
Clothe me, I pray thee, against
The ravages of the winter freeze,
The damaging rains of spring,
The choking dust of summer,
Give me a new coat in the fall
That I may give you pleasure,
Profit and happiness
The whole year 'round.
Treat me kindly, considerately.
Let not my body become
Disfigured, worn, and ragged.
I give to you my all,
Give me liberally of your substance
That I may give you even more.
You will never be more liberal than I
For *I Am a Friend of Man.*

* * *

## New Road Commissioner in Kentucky

Rodman Wiley, of Georgetown, Kentucky, was appointed Commissioner of Public Roads of Kentucky by Governor Stanley on June 28. Mr. Wiley succeeds Mr. Robert C. Terrell under whom he has been serving as Chief Bridge Engineer of the Kentucky department.

* * *

Sealed bids will be received until twelve (12) o'clock, noon, August 8, 1916, for the re-construction of the county road between Bedford and Campbellsburg, as extends from Ewing Ford to Henry County line, in Trimble County.

Plans and specifications will be found on file in the County Clerk's office of Trimble County, or, at the office of the Department of Public Roads, Frankfort, Kentucky.

* * *

The Trussed Concrete Steel Company won the suit filed against it by the Berger Manufacturing Company. The decision was rendered by Hon. John H. Clarke, United States

District Judge at Cleveland, Ohio, and the following is a copy of the final entry in the case.

April term, A. D., 1916, towit: June 16, 1916.

Present: Honorable John H. Clarke, United States District Judge.

The Berger Manufacturing Company vs. Trussed Concrete Steel Company, No. 313 Equity.

This cause having been submitted to the Court at a previous day of the present term of this court on the testimony and argument of counsel, upon consideration thereof, it is

Ordered, adjudged, and decreed that claim one of Letters Patent of United States No. 682,316, dated September 10, 1901, issued to William L. Caldwell, is void for want of patentable novelty and invention, and it is further ordered that the bill of complaint herein be and the same is hereby dismissed at the cost of complaint.

In this connection we are pleased to say that Hon. John H. Clarke, the judge who rendered the final decision in the case of the Berger Manufacturing Campany vs. the Trussed Concrete Steel Company June 16, 1916, has just been nominated by President Wilson as associate justice of the Supreme Court of the United States to succeed Judge Hughes, who resigned to accept the Republican nomination as a candidate for president.

* * *

## The Crystal Park Auto Road

### Colorado Springs, Manitou

This road was begun October 3, 1909, and completed October 31, 1910.

It has been adjudged to be one of the world's greatest engineering feats and completed in a remarkably short time.

The total length is eight miles and the greater portion of the road was blasted out of the solid rock. It is as smooth as a pavement and overcomes 3,000 feet in elevation, the park terminus being over 9,000 feet above the level of the sea. The grade varies from two to six and half per cent. and from vantage points enroute to Crystal Park an all-inclusive view of the entire region is unfolded. The surface is cared for by Armco Iron Culverts.

The trip is almost entirely through rugged country; peaks, canons, and ridges are spread out before you like a series of paintings, while some of the sublimest views to be obtained on any mountain trip in the world are presented to view as far as the rugged horizon.

It is the luxury of mountain climbing and has repeatedly been spoken of by world wide travelers as the scenic wonder mountain motor trip of the world.

The road is open for motorists to drive over in their own cars, for which a reasonable toll charge is made.

* * *

## The Nineteenth Annual Meeting of the American Society for Testing Materials

The nineteenth annual meeting of the American Society for Testing Materials, held at the new Hotel Traymore, Atlantic City, New Jersey, the last week in June was, without any question the most interesting and the most important meeting that has ever been held by this well-known and most important Society. The attendance was larger than at any of the previous meetings, passing the new record for attendance made at the 1915 meeting. The attendance at the last session showed a registration of 513 men and 130 ladies, a total of 643, as against 489 men and 103 ladies, a total of 592, the record attendance of 1915.

From the standpoint of importance the meeting also eclipsed all other meetings of the Society. New standards and specifications were acted upon and steps taken toward the final disposition of some most important problems, including the new specifications for Portland cement, an account of which will be found on another page of this issue of Better Roads and Streets. Important action was also taken on the report of Committee D-4 on road materials, in which a great many very important changes were made. This detailed report in its final form will be published in an early issue of Better Roads and Streets, just as soon as it comes in final shape from the committee.

The first fifteen sections of the revised Portland cement specifications will, as stated above, be found on another page. The methods of tests, which it was expected would be in shape to publish in full in the next issue, will not, however, be available, as there are a number of important points upon which the committees of the Government, the American Society of Civil Engineers and the American Society for Testing Materials have not yet completed their efforts. These Methods of Tests will be presented at the earliest opportunity.

Important action was taken on the recommendation of the Executive Committee when it was agreed to vote to replace the "Year Book" of the Society by a biennial publication to be called the "American Society for Testing Materials Standards." All tentative specifications are to be printed in the proceedings of the Society. This was ordered to be submitted to letter ballot.

The Executive Committee reported that arrangements have been made with the United States Department of Commerce by which the standards of the Society which bear upon export trade will be translated into foreign languages. All of the thirty-one standards of Group One and twelve Standards of Group Two have already been translated into Spanish.

The total membership of the Society, including 210 junior members, is now 2,071. This shows a greater increase than for any previous yearly period, even though the dues were increased fifty per cent. at the beginning of the current fiscal year.

In the financial situation and condition of the Society, the report of this committee contained the following self-explanatory paragraph:

"From present indications it is to be anticipated that, barring expenditures in unexpected directions, the deficit of $6,407.03 at the beginning of the fiscal year will not only be extinguished, but will be converted into a moderate surplus by the end of the year, and that the financial affairs of the Society will thereafter be on a thoroughly sound business basis for the first time in the history of the organization. The cash balance in the treasury June 1, 1916, was $15,666.86 with no unpaid bills, as compared with a cash balance of $6,480.79 at the corresponding period last year.

At the annual election of officers, A. A. Stevenson, of the Standard Steel Works, Philadelphia, was elected president for the coming year. S. S. Voorhees, of the Bureau of Standards, Washington D. C., was elected vice-president. Professor Edgar Marburg, of the University of Pennsylvania, Philadelphia, was re-elected secretary. The new members of the executive committee are W. H. Bassett, John Brunner, G. W. Thompson, and F. E. Turneaure.

Owing to the fact that on other pages of this issue will be found detailed reports of the committees of the Society in which the readers of Better Roads and Streets are interested, these will be omitted from mention in this notice of the meeting.

* * *

## When and How to Work Sand-Clay Roads

The sand-clay road is one of the important types of road in many parts of this country, as it is found in considereble mileage in the majority of the States, although principally in the South and Middle West. The total mileage of roads of this type will surprise many, for there were on January 1, 1916, according to the most complete reports obtainable, no less than 37,500 miles of these roads. About 25,000 miles are in the Southern States, with the balance distributed in almost every section of the country.

The sand-clay road is only too often sadly neglected. Like the earth road, if it is to be kept in the best condition, it needs constant maintenance. And much maintenance, or rather repair, will be saved (and incidentally considerable expense) if the maintenance starts at the right time, and the road is given the proper overhauling at the proper time.

The sand clay road should be worked while the soil is damp, but not while it is so muddy that it is sloppy. The mistake is only too often made by starting to work the road of this type while it is a sea of mud, and this usually results in the separation of the mixture of sand and clay, and the ultimate destruction of the entire surface. The work should never be put off until late in the summer after the road has become thor-

oughly dried out, and generally speaking, it can be safely worked and economically worked up to the first of July, and in some sections even later. But if the road is in a section where there has been but little rainfall during the spring and late summer, and has therefore become well dried out, it will be much more difficult to put the road in proper shape, and the cost of doing the work will also be considerably more.

Sand-clay roads, so far as is known, were first constructed about 1894, when small mileages were constructed in a number of the Southern States, and in both Eastern and Western Pennsylvania, New Jersey, and several other States. The roads built in that year were more or less of an experiment, brought about by the desire in several sandy localities to be able to construct a cheap road, using the sand and some clay that was conveniently located, and in other sections to get a road that was cheap and which would not be so dusty or muddy as the ordinary earth road. Localities in the latter class usually had sand banks in the vicinity of the earth roads that they wanted to convert into sand-clay roads. From the first, the road grew in popularity, as it was found that it was much better than a clay road at all seasons of the year, and that it was, at the same time nearly as cheap to build as the clay road. It was found, in addition to being cheap, to be comparatively firm and durable, as the materials used in construction bound firmly together. These materials were to be found in almost every section of the country, so that little hauling was necessary, and after the materials were on the site of the road, it was comparatively easy to construct it.

The construction of the sand-clay road, which is a mixture of sand and clay, as the name signifies, is simple. The materials are mixed in such proportions that the grains of sand touch each other, with the space between these gains just filled with the clay, the latter acting as a binder. The approximate mixture of sand and clay can fairly accurately be determined by filling a flask with a sample of the sand which it is proposed using, and then filling another flask of exactly the same capacity with water. The water is then poured carefully into the flask containing the sand until it just reaches the point of overflowing. The volume of water that has been removed from the flask that was filled with water will approximately represent the proportion of clay that will be required to properly fill the voids of and bind the sand.

However, it has been found that in almost all cases, the proper proportion of sand and clay can be best determined by actual observation as the work progresses, as some clays will naturally be found to contain more sand than others. In fact, in many parts of the country, clays are very frequently found which already contain, in the natural state, just about the right proportion of sand.

In the case of an existing road, if the surface to be worked over and treated is found to be sandy, the surface should first be leveled off and crowned. The best way to do this is with a road grader. The crown thus given should be about one-half inch to the foot from the center to the sides, or one-half the width of the roadway proper. The clay should then be dumped on the surface and spread carefully, all lumps being broken up. This layer of clay should be spread from six to eight inches thick, or deep at the center, and should gradually decrease in depth toward the sides. After this layer of clay is well leveled off, a layer of clean sand is added, and then thoroughly mixed with the layer of clay, either by traffic, or preferably by means of plows and disc or tooth harrow.

The best results have been obtained in almost all cases by thoroughly mixing or puddling the materials while they are wet. For this reason, therefore, it is desirable that the mixing be done during wet weather, and the mixing can be left to the traffic that will use the road after the materials have been properly proportioned and placed, if the funds are limited and the users of the road will not object to the road remaining in bad condition for some time after the material has been placed. This latter method is not desirable, or in accordance with good practice, however, as it generally means a winter and spring of bad roads, with a chance that the material will not be mixed satisfactorily. In every case it is advisable to dress the road with a road machine or with a road drag after the materials have been thoroughly mixed, and to give it, during this operation, a crown of not more than one inch nor less than three-fourths of an inch to the foot of width from the center to the sides. A light coating of sand should then be added to secure the best results. After the road has been opened, the use of the road machine or the road drag should be continued at as frequent intervals as necessary until the surface is found to be free and firm, and also at the first appearance of ruts after the road has been in use for some time. No better implement for maintenance can be found than the systematic use of the road drag following rains when the road shows that it is in need of such treatment.

If the road to be treated is composed of clay, it should be first brought to the rough grade by the use of the road grader. Then the surface should be thoroughly broken up and pulverized by plowing and harrowing to a depth of not less than four inches, and not more than six inches, although five inches will generally be found better. It is then given a crown of about one-half inch to the foot of width from the center to the side, after which the entire surface should be covered with from six to eight inches of sharp sand. This layer of sand should be placed or spread deeper in the center than at the sides.

While these materials are still comparatively dry, they should be thoroughly mixed by plowing and harrowing, after which the surface is well puddled with a harrow during wet weather, or following a good rain. If it is found that clay works to the surface, which will cause the road to become sticky, more sand should be added without delay.

The road should then be shaped, crowned and ditched in the usual manner with the road machine, but it is important to bear in mind that this part of the work should be done while the surface is soft, although just stiff enough to pack well under the roller or under traffic, whichever method of compacting may be used in the particular case. Wide but shallow ditches should be provided on both sides of the road wherever possible, and culverts and cross-drains should be placed wherever it is found that there is any danger of water flowing across the road, as well as at convenient points to dispose finally of the water from the side ditches. It is of the greatest importance that the sand-clay roads built by the "sand on clay" method be well drained.

After the sand-clay road, whether built by the "sand on clay" or by the "clay on sand" method, has been completed, it should, if the best results are to be obtained, be carefully maintained by the use of the road drag until it has become firm and smooth. The construction of the sand-clay road is not a quick operation by any means, and it requires a considerable amount of common sense mingled with proper care and proper methods. If soft and sticky places are found to appear, more sand should be added immediately, while on the other hand, if loose and sandy places are found, more clay should be added. And it must not be lost sight of that it is just as important to attend to these small details as it is to attend to any other part of the work, for if they are neglected, there is the certainty that the road will fail in these places to a greater or less degree.

It will require approximately one cubic yard of clay to surface one and one-half lineal years of road twelve feet in width, which is about 1,175 cubic yards to the mile. From three-quarters of a yard to a yard will make a load for a team of horses on a dry clay road. The cost of the work described on a road of this type will depend largely on the distance it will be necessary to haul the material, but the general average is from five hundred to a thousand dollars per mile twelve feet in width. The thickness of the road will average nine inches. Where possible and the money is available, it is always desirable to build such a road fourteen feet wide, and where the traffic is considerable, it should be built sixteen feet wide. Generally speaking, and from the standpoint of traffic, a road twelve feet wide will not serve the traffic any better than will a road eight or nine feet wide, as vehicles will be compelled to turn off the surface in passing.

# Better Roads and Streets

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Subscription Agents Wanted Everywhere. Good Commissions


July was a hot one and there is plenty of dust everywhere.

* * *

A contract for the construction of forty-seven miles of hard surfaced gravel road ten feet wide has recently been let in Yellowstone County, Montana.

* * *

Every cloud of dust that leaves the road represents road material paid for by the taxpayer at from $8,000 to $20,000 per mile.

* * *

It is not for this publication to say what material must be used to keep down the dust, but we don't hesitate to say that there are several materials that will do it.

* * *

E. R. Marker, district manager of the T. L. Smith Company moved to new quarters at 609 Wells Street, Milwaukee, Wisconsin, on July 1. Mr. Marker will carry a stock of Smith mixers and a complete line of contractor's supplies.

* * *

Logan Waller Page, director of the office of Public Roads and Rural Engineering at Washington, D. C., will have direct charge and supervision of all details of the administration of the Federal Aid road law which is published on page three of this issue.

* * *

Publicity from the Texas Good Roads Association announces a Good Roads Congress at San Antonio, Texas, Medina Lake, August 17, 18, and 19. Three days and nights full time devoted to the most popular subjects of the United States to-day.—*Good Roads and Fishing.*

* * *

The Sterling Motor Truck Company, of Milwaukee, Wisconsin, has just issued new circular of descriptive matter relative to their five-ton and seven-ton dump trucks. The operation and design of their trucks show the careful attention they have given the requirements of the road and street contractor in the use of the motor truck for hauling purposes.

* * *

Every State, county, township, city, and village road enthusiast should give careful reading and analysis of every detail of the Federal Road Bill beginning on page three of this issue, which passed both houses of Congress, was signed by the President on July 11, and is now the law of our nation so far as Federal co-operation with the States in road construction is concerned.

In years past to apply a dust laying material it was necessary to spray it on the road with hand sprinklers or cumbersome horse-drawn gravity distributors, but in this year of our Lord, 1916, motor driven pressure distributors are successfully used, and instead of requiring a whole day to apply a dust layer to one block of a dirty street, several miles of streets or roads can be treated between sun-up and sun-down, and just now when labor is busy in so many channels—makin' hay on the farm and makin' bullets in the factory—the motor driven pressure distributor is a real necessity.

* * *

The assistant editor of this publication was married on July 22. Some hot time, George.

* * *

*Which*
Which.
*Where*
To lay it.
*When*
To get at it.
This reference is to the
*Type for the place.*

* * *

The editor of this publication is not a consulting engineer and would therefore hesitate to attempt to give a formula and prescribe the type for the place, and would no doubt be shot by the first material manufacturer he would meet, but he is endeavoring to pound it into the road and street authorities and engineers whose duty it is to make such prescriptions, for it is clear to him that the only intelligent application of road materials is first by proper and unbiased consideration of "What is the Type for the Place?"

* * *

## Road Machinery Supersedes Hand Labor

Consul Homer Brett, at La Guaira, Venezuela, reports that the policy of the department of public works in its road building hitherto has been to use hand labor exclusively, so as to give employment to as many persons as possible; but recently a number of wheeled scrapers were bought in the United States, and after they had been tested officially it was announced that one man with a scraper accomplished the work of twenty men under the old methods.—*Daily Consular and Trade Reports, Department of Commerce.*

* * *

All civil engineers who have a desire to become connected with the office of Public Roads and Rural Engineering in the administration of the Federal road law should immediately get in touch with Logan Waller Page, director of the office of Public Roads and Rural Engineering, Washington, D. C., or the National Civil Service Commission, Washington, D. C., and take one of the examinations which are to be held at an early date. Many engineers will be required under the Federal road law and salaries ranging from $2,000 to $4,000 per year will be paid. A position once secured in this way cannot be interfered with by any cheap politician who has been elected to the office of governor of his State, and proper efficiency in road engineers can only be procured through civil service.

* * *

## Tests of Road-Building Rock

### Results of Government Experiments to Ascertain the Physical Properties of Different Materials

The results of a large number of recent physical tests of road-building rock have been published by the United States Department of Agriculture as a professional paper, Bulletin 370. These tests have been made by the office of Public Roads and Rural Engineering to give highway engineers information in regard to the various physical properties of the different rocks most frequently used in road construction. The three most important of these properties are defined in the bulletin as *hardness*, or the resistence which the rock offers to the dis-

placement of its surface particles by abrasion; *toughness,* or the resistence which offers to fracture under impact; and *binding power,* or the ability which the dust from the rock possesses, or develops by contact with water, for binding the large rock fragments together.

* * *

Bids will be received until twelve o'clock, noon, Wednesday, August 9, 1916, by the County Court of Wetzel County, West Virginia, for the construction of approximately fifteen (15) miles improved roads in Church District of said Wetzel County. A certified check for two (2%) per cent. of the amount of the bid must accompany each bid.

Successful bidders will be required to furnish bond substantially in wording and figures of the form attached to specification and contract.

Plans for this work may be seen at the office of the County Clerk, New Martinsville, West Virginia, and at the office of the Engineer, J. Russel Wilson, First National Bank Building, Mannington, West Virginia.

The court reserves the right to reject any and all bids.

S. MYERS,
Clerk of the County Court of Wetzel County.

* * *

The editor of this publication was a regular "old line" Republican until four years ago. The horns have been taken off the "Bull Moose" to adorn libraries in private homes and art gallaries, the carcass has been cremated, but some one had better not ask the editor if he is physically able to do so, to go to Missouri and make speeches for Shackleford or to Alabama to make speeches for Bankhead if he does not want the editor to go into both these States during the fall campaign, for he has always been loyal to every public official who favors more roads and who earnestly advocated some method for co-operation and some way to get the money for Federal and State co-operation in road construction. We are a firm believer in proper and constant maintenance of roads constructed, but, Mr. Reader, always remember that the Federal road law provides that the States which receive co-operation must themselves take care of all roads constructed under the provisions of our Federal road law, and unless the States do maintain them, as provided in the law, the penalty for failure to do so is to forfeit all claims for future aid in construction. Do you get this last statement?

* * *

The office of Public Roads and Rural Engineering, of which Logan Waller Page is director, is a bureau in our United States Department of Agriculture, and while many references are made, in the Federal Road Law, to the Secretary of Agriculture, we are glad to state that all the recommendations of Director Page will be carefully considered by the Secretary of Agriculture before any formal or final action is taken, and it is probable that no final recommendations will be made by Mr. Page for the administration of the law until a conference is called, probably to be held at Washington, D. C., and to that conference will be invited all State highway commissioners and members of State highway commissions. We are also informed that no bulletins setting forth instructions for the administration of the law will be published and issued until such a conference is held. Therefore, Mr. State Highway Commissioner, and Mr. Member of a State Highway Commission, it is vitally important to you and your State that you attend such a meeting when called, and that you take an active interest in the meeting. We have no special authority to make this statement but from what we know of Mr. Page during past years we believe this to be his earnest desire.

* * *

Some people do not agree with the plan set forth in the Federal road law but the State of Missouri, and people of all the States, owe a great debt to Congressman Dorsey W. Shackleford, Chairman of the House Committee on good roads. This is also true of Senator John H. Bankhead, Chairman of the Senate Committee on Postoffice and Post Roads, and the State of Alabama, and the people of the nation, owe to him a great debt, for both of these men, Bankhead and Shackleford, never let up in their strenuous efforts for the passage of a Federal road law and now both of them have the satisfaction of knowing that their respective bills before the Senate and House, have been embodied in the report of the House and Senate Conferees, the report of the conferees adopted by both Houses, sent to the President and signed by President Wilson on July 11, 1916. These two men have a record of which they can both be justly proud and can both return to their respective States and have the people unanimously say, "He made good. Let us send him back to Washington."

* * *

As a stimulus to road building and improving the motor speedways in various parts of the country races seem to be playing a decidedly prominent part. Evidence of this fact is found in the experience of the managers of the new Cincinnati Speedway, which is to be inaugurated with a 300-mile, $30,000 race under the auspices of the A. A. A. on Labor Day, September 4, in connection with the big event. As soon as work had progressed sufficiently far on the new two-mile course to make it certain that the inaugural would take place as scheduled, the county commissioners of Hamilton County, in which Cincinnati is located, immediately began a resurvey of the various roads leading to the Speedway, ascertaining just what improvements were needed to place these highways in the best possible touring condition for the big event. As soon as the necessary data was secured contracts were let for the improvement, and the work now is being pushed as rapidly as possible in order that all Hamilton county roads leading to the Speedway will be in first class condition by September 1.

Advices received from various sections on the Dixie Highway also bring assurances of activity in the improvement line, due to a desire on the part of hundreds of motorists in the south to tour along the Highway to Cincinnati for the big race and for the Dixie Highway convention and exposition which will be held in Cincinnati from September 1 to 9.

* * *

## United States Civil Service Examination

### Senior Highway Engineer—August 6, 1916

The United States Civil Service Commission announces an open competitive examination for senior highway engineer, for men only. From the register of eligibles resulting from this examination certification will be made to fill vacancies in this position in the office of Public Roads and Rural Engineering, Department of Agriculture, and vacancies as they may occur in positions requiring similar qualifications, unless it is found to be in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion.

Now that the Federal Aid Road Bill has been agreed upon by the Senate and House Conferees, was signed by the President and became a law on July 11, some of the highest positions involved may be filled from the register of eligibles resulting from this examination.

Appointees to this position will be designated senior highway engineers, with salaries ranging from $2,220 to $4,000 a year. Only those eligibles who obtain a rating of eighty-five per cent. or over will be eligible for appointment to positions paying $3,000 or over.

This examination is open to all men who are citizens of the United States and who meet the requirements.

Persons who meet the requirements and desire this examination should at once apply for Form 1312, stating the title of the examination desired, to the United States Civil Service Commission, Washington, D. C.; the secretary of the United States Civil Service Board, postoffice, Boston, Massachusetts; Philadelphia, Pennsylvania; Atlanta, Georgia; Cincinnati, Ohio; Chicago, Illinois; St. Paul, Minnesota; Seattle, Washington; San Francisco, California; customhouse, New York, New York; New Orleans, Louisiana; Honolulu, Hawaii; old customhouse, St. Louis, Missouri; administration building,

Balboa Heights, Canal Zone, or to the chairman of the Porto Rican Civil Service Commission, San Juan, Porto Rico. Applications should be properly executed, including the medical certificate, and must be filed with the commission at Washington prior to the hour of closing business on August 8, 1916. The exact title of the examination as given at the head of this announcement should be stated in the application form.

* * *

## The Salt Lake-Yellowstone Highway

### Recently completed from Great Salt Lake through Utah and Idaho to Yellowstone Park through the efforts of the Utah-Idaho Yellowstone Highway Association

ONE of the latest and most important achievements in the progress which has been made in the western United States in building highways along the principal auto thoroughfares adopted by joint-State highway systems to connect with the nation-wide system of good roads is the completion of the Salt Lake-Yellowstone Highway from Salt Lake City and Ogden, Utah, through Pocatello, Idaho, (the junction with the Idaho-Pacific Highway or Oregon Trail to the Northwest) to the Yellowstone National Park.

For many years large amounts of money have been spent by local county governments and road organizations on different sections of this route. Several years ago the route now completed was adopted as a joint State highway of Utah and Idaho, and large appropriations from the States have been expended in its construction. In the early part of this year the Utah-Idaho Yellowstone Highway Association was formed to take over the work of about twenty-five smaller, local organizations along the route, the road associations, county commissioners of each of the seventeen counties along the highway and the State highway commissions of Utah and Idaho, participating in and becoming identified with the big association.

The by-laws of the new association instructed its officers to unify the highway work along the entire stretch of highway, to induce the improvement of sections needing repair in order to carry heavy traffic in comfort and safety, to secure new construction wherever necessary, to shorten the mileage and avoid bad location, to make the necessary arrangements with



State and county officials to maintain and patrol the highway during the present and ensuing seasons, and to work to eventually complete the route as a hard-surface highway.

Hon. Mark Austin, of Rexburg, Idaho, one of the foremost advocates of good roads in the Northwest and a managing official of the large string of beet sugar factories in Idaho and Utah, heads the organization as president. C. C. Dietrich, of Idaho Falls, Idaho, an indefatigable worker in the promotion of good roads, and former private secretary to United States Senator James H. Brady, of Idaho, handles the work of secretary and treasurer of the seventeen-county association.

For many miles the Salt Lake-Yellowstone highway passes along the bench lands of the valleys, through a natural road-making material, of mixed sand, gravel, and earth. Along these stretches the natural formation has been utilized in making the highway. In Utah the highway for a long distance has been concreted. In many sections macadam has been agreed upon between the State and county officials as the best material, and a large portion of the highway has been gravel capped from nearby natural gravel pits.

The campaign, which has been carried on by President Austin and Secretary Dietrich, with the assistance of an Executive Committee and a Vice President in each county included in the association, has resulted in a large amount of repair work and new construction being done, and the perfection of arrangements with the county commissioners to maintain and patrol the highway throughout the heavy traffic season.

A short section of new construction now being carried on under the auspices of the association, co-operating with the State of Idaho and the United States Forest Service in the Targhee National Forest, lying along the western border of the National Park has been delayed on account of the backwardness of the season in the mountains, it is announced by the officials of the association, but that construction is progressing as fast as the snow recedes with but three weeks work yet to be done.

The construction of this new section does away with a few bad hills and dugways on the present route through the forest, which were difficult of maintenance, and diverts the travel by way of the two Upper Falls of the North Fork of Snake River, Bear Gulch, and the Famous Warm River Canyon on the Harriman route to the National Park.

The remainder of the highway, it is further stated, is now in perfect condition for heavy travel, and the entire highway, including the new construction through the forest, will be in first class condition by the time cars may safely enter the Yellowstone Park.

The completion of this important link in the National Highway System makes possible the routing of auto traffic off the Lincoln Highway, Pike's Peak Route, the Midland Trail from



the East and the Lincoln Highway from California and the coast, at the converging points at Ogden and Salt Lake over this trunk highway, through Pocatello, to the Yellowstone National Park. Traffic out of the western entrance is also carried by this highway to the junction point with the continental routes at Salt Lake and Ogden. Traffic going either way may diverge at Pocatello, Idaho, for the entire Northwest, or vice versa, and from this and other points along the route on good highways to all the wonderful scenic regions and famous fishing and hunting sections of Utah, Idaho, and Wyoming.

The main Salt Lake-Yellowstone Highway passes through the greatest agricultural development of Utah and Idaho, along the great snow capped mountain ranges, through picturesque canyons, skirting beautiful rivers and mountain streams—a great panorama of wonderful mountain scenery which, in many instances, equals if not excels the beautiful sights of the great Yellowstone Park.

Not only does it serve the overland traveler, but its route along the natural geography of the country makes it the basis of a vast net work of county highways and side roads leading to it. It is the main market-way for the people of seventeen densely populated counties of the two States through which it passes, and the principal highway in a large number of highway districts organized along the route.

A permanent headquarters for the Utah-Idaho Yellowstone Highway Association is maintained at the office of the secretary at Idaho Falls, Idaho. Its officials state that they propose to vigorously continue the fight for good roads in the inter-mountain country until every settled community within reach of the highway is placed upon a well built feeder road, and the main highway itself is hard surfaced the entire way. A bureau of information concerning the work of the associa-

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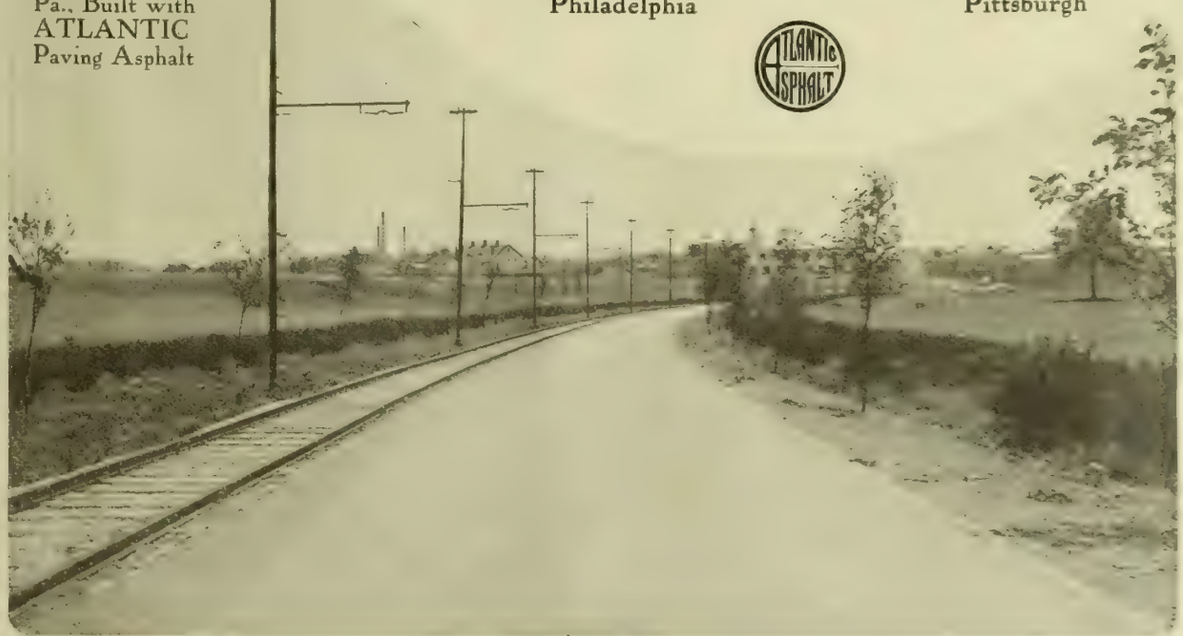
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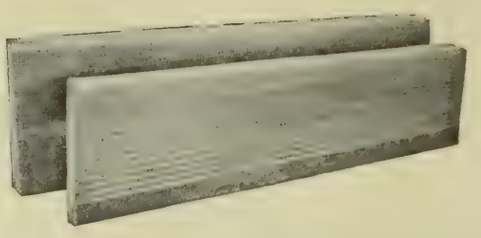


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tion, and the districts reached by the highway and auxiliary roads, is maintained at headquarters. A log of the highway has been issued under the auspices of the association, and this and any other information concerning the status of road building along the route may be secured from the secretary.

* * *

## Frank B. Black Appointed State Highway Commissioner of Pennsylvania

Frank B. Black, of Meyersdale, Somerset County, Pennsylvania, was appointed State Highway Commissioner of Pennsylvania by Governor Brumbaugh on July 1, filling the vacancy created by the death of Robert J. Cunningham, which occurred on April 26. Commissioner Black took the oath of office on Wednesday July 5, and immediately thereafter assumed control of the Department. His first official act was to issue a statement in which he said that he would carry out, as far as possible, the policy instituted by his predecessor, and that he would give the State Highway Department an efficient and businesslike administration.

The new State Highway Commissioner was a member of the State Board of Agriculture to which he was appointed by Governor Brumbaugh on June 10, 1915.

Frank B. Black was born at Somerfield, Somerset County, April 17, 1864, and has lived in the county of his birth all his life. He comes from sturdy ancestry and a pioneer family of the Youghiougheny River section of Somerset County. His father, the late George J. Black, was a man of ability, industry, and enterprise, traits which are characteristic of the family. The elder Black was a pottery manufacturer, merchant, and farmer, and was elected to the office of Associate Judge and County Treasurer, which positions he filled with signal ability.

The family removed from Somerfield to Meyersdale in 1873, and the newly-appointed State Highway Commissioner grew up in the latter town and received his education in the public schools there. At the age of eighteen he was much further advanced in business experience than most men of thirty, and at that early age he purchased his father's pottery and branched out into the drain tile and brick business which he conducted for fifteen years. At that time he became interested in coal mining, and began opening and operating coal mines in various parts of the country. He organized and developed many properties, selling them when he had them well established. For some years, with several associates, he mined and sold coal through their own selling agency in New York, under the firm name of the Black, Field, and Emmons Company. In 1907, he organized the Atlantic Coal Company which has mines at Boswell and Blackfield. This company is a large producer of coal and employs between 500 and 600 men. It has two of the best equipped and best managed coal mining plants in Somerset County, both of which have been under the personal direction of Commissioner Black.

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**Placed a "Repeat Order" with us as follows on April 13, 1916:**

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☞ "The above culvert to be same quality as the lot of 400 lineal feet furnished by you under our Order No. 44350 from this office of September 22, 1914."

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State Highway Commissioner Black on July 6, announced the promotion of two employees of the department to fill county superintendencies. The promotions were made on the recommendation of Chief Engineer Uhler.

George P. Clay, forty-five years old, an inspector at present in the Fourth Engineering District, with headquarters at Franklin, is promoted to be Superintendent of Erie County, taking the place of L. E. Van Vleck, resigned. Mr. Clay has been with the department ten years, having started as a chairman and worked his way up. He has been an inspector of telford macadam and brick pavement, foreman in charge of resurfacing operations and draftsman. His home is in Emlenton.

B. B. Weinberg is made Superintendent of Blair and Cambria Counties, taking the place of A. J. Fasenmyer, resigned.



FRANK B. BLACK
Newly Appointed State Highway Commissioner of Pennsylvania. Appointed July 1, 1916. Home, Meyersdale, Pennsylvania

Mr. Fasenmyer had been appointed to fill the vacancy caused by the resignation of R. L. Devereaux, but before taking active charge of his district resigned from the State Highway Department to accept a position in West Virginia. Mr. Weinberg is a civil engineer, and a graduate of Pennsylvania State College. He came with the State Highway Department in 1913 and was at first located at Harrisburg, but later was transferred to the Fourteenth District with headquarters at Washington. He has been an inspector and is considered a competent man. His home is in Monessen.

In making announcement of these promotions, Commissioner Black said that he intended to adhere firmly to the policy established by late State Highway Commissioner Cunningham in filling vacancies by promotions from the ranks of the employees of the Department. He emphasized the fact




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that merit and efficiency would be the governing factors in the selection of men for responsible positions in the work of the State Highway Department.

* * *

## For "Uncle Sam"

Two carloads of big machines consisting of the largest size elevator graders, Russell Mogul road machines with twelve-foot blades and road plows was recently sold to the United States War Department by the Russell Grader Manufacturing Company, of Minneapolis, Minnesota, to serve in constructing roads on the Mexican border.

This order is especially interesting in that it was ordered to go forward by Wells-Fargo express, and is probably the largest shipment of its kind ever moved from the Northwest. The shipment weighed approximately 50,000 pounds and the express charges were $3,100.25. The entire shipment was put under way within forty-eight hours.



Since the above order was shipped the Russell Grader Manufacturing Company have received additional orders for three large size elevating graders and a carload of road machines.

It is reported these machines will be used in rebuilding an old railroad right of way now used as an automobile road to the American army base at Casas Grandes, over which the military supplies are being hauled by automobile trucks.

* * *

The tremendous impetus which road building has developed during the past decade has brought in its train a question of equal importance, namely, the economical maintenance of roads after they are built. This subject is even more pressing in the




POURED OR TAMPED

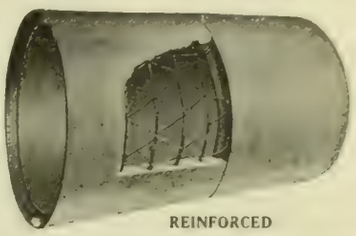
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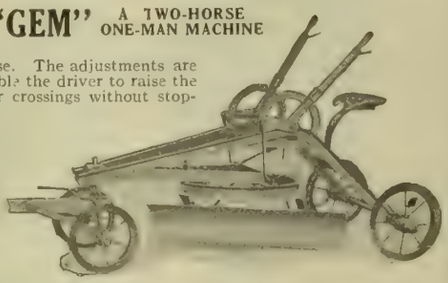
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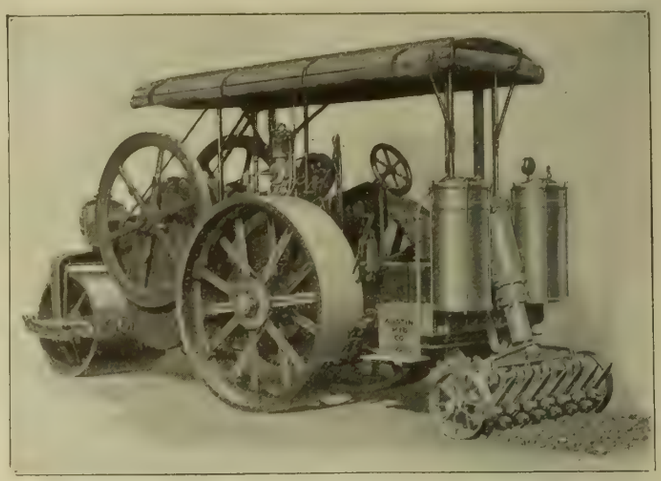


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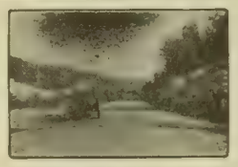
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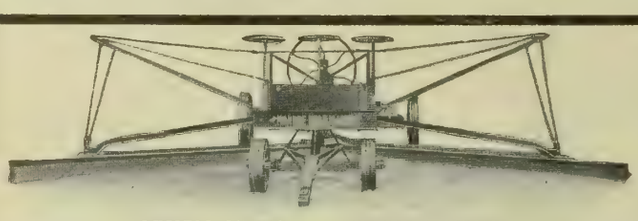
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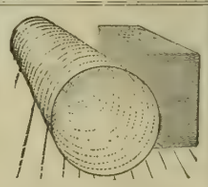
**N. S. MONROE & SONS** ESTABLISHED 1894 **ARTHUR, ILLINOIS**

AMERICAN SHEET & TIN PLATE CO. APOLLO BEST BLOOM TRADE MARK REGISTERED PITTSBURGH KEYSTONE COPPER STEEL

**APOLLO-KEYSTONE**

**COPPER STEEL Galvanized Culvert Stock**

Demand this material in your CULVERTS—it insures the greatest possible durability and resistance to rust and corrosion. Actual time and service is the proof. Look for the Keystone added below the regular Apollo trade-mark. Send for booklet.



**AMERICAN SHEET AND TIN PLATE COMPANY,** —— **General Offices: Frick Building, Pittsburgh, Pa.**

*Quality—Service*

TELL 'EM YOU SAW IT HERE.




# If they specify a 2 minute mix

**It seems probable that engineers will specify a two minute mix, maintaining that it makes concrete about ten times stronger than one minute mixing.**

This increased mixing time could be met only one way by the contractor—by the use of big capacity mixers—extra fast in charging and discharging, and distribution.

The Koehring mixer exactly meets the demands.

The Koehring has always been the principal big capacity line.

The Koehring organization is specialized in heavy duty construction—the many special problems of big capacity construction have been solved.

This is why the Koehring mixer has, to-day, the liberal design, strength, and safety margin construction indispensable in big capacity mixers—why the Koehring will not show weakness under continuous full-capacity operation.

The self-accelerating loading skip means time-saving on the loading end without the extra strains, otherwise indispensable from fast skip operation.

The Koehring fast discharge, together with the Koehring extra automatic boom and bucket system means speedy distribution, easy one-man mixer control, and worth-while extra yardage on every day's work.

## Koehring Sizes in Cubic Feet Capacities

Mixers for construction work: 4, 7, 10, 12, 15, 20, 24, 30, 44. Equipped with low charging hopper, batch hopper, and side loader.

Hot mixers for bituminous pavements: 12, 20, 22. Side discharge type and end discharge type.

Paving mixers: 6, 11, 16, 22. Equipped with distributing boom and bucket or spout.

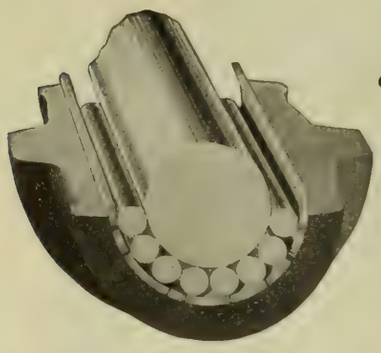
Gasoline power, steam power, or electric power.

Write for booklet series C-22, each booklet is a five-minute talk on a vital point of mixer construction. Such as you must know to judge mixer value.

## Koehring Machine Co., Milwaukee, Wis.



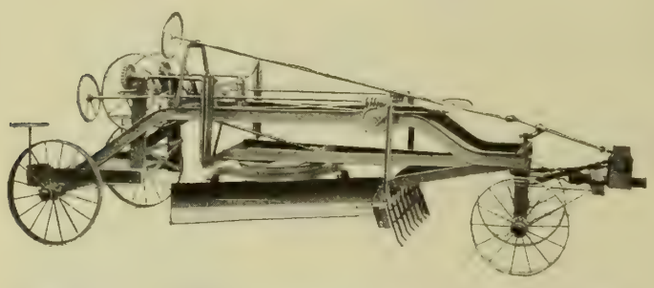

## This Is Just One of the Superior Features of "Panama" Road Machines



*"Panama" Roller Bearing Wheels*



RACTICALLY every machine in the "Panama Line" is equipped with roller bearing wheels and this is just one instance of the thoroughness and superiority of "Panama" construction. No detail is too small to receive the most careful attention and every known good point of road machine construction, as well as several exclusive features, are incorporated in each machine of the "Panama Line."



## The "Panama Giant"

*Leader of the Line*

This big, heavy machine, embodying all the good points ever incorporated in a machine of this kind, as well as several "Panama" features, is not only the leader of the "Panama Line" but the leader of all the road machines on the market.

The "Panama Line" comprises road machines of every size and weight, one for every job, down to the "Panama Junior" weighing only 600 lbs.

Our catalog gives a complete description of each machine. Mail the coupon for a copy.

MAIL OR USE FOR MEMORANDUM

The F. B. Zieg Mfg. Co. Fredericktown, Ohio.

Gentlemen:-
Send your catalog as offered in Better Roads and Streets.

Name.....

Address.....



THE F. B. ZIEG MFG. COMPANY
*Fredericktown, Ohio*

TELL 'EM YOU SAW IT HERE.


The Shawmut Paving Brick Works, of Shawmut, Pennsylvania, and the Pennsylvania Clay Company, of Pittsburgh, Pennsylvania, have become licensees of the Dunn Wire-Cut Lug Brick Company.

The Shawmut company has an approximate daily capacity of 30,000 paving brick, but the company is contemplating the enlargement of the plant to a 50,000 daily capacity.

The Pennsylvania Clay Company, has one plant at Conway, Pennsylvania, with a capacity of 60,000; one plant at Crows Run, with a capacity of 60,000, and one plant at Bradys Run, Pennsylvania, with a capacity of 40,000.

The acquisition of these two companies gives the Dunn Wire-Cut Lug Brick Company thirty-two licensees, operating fifty-two plants.

* * *

That the new Cincinnati Motor Speedway, now in course of construction at Sharonville, Hamilton County, will exert a decided influence on road improvement in this vicinity was evidenced at the meeting of the commissioners of Hamilton County some days ago. Resolutions were adopted ordering the immediate improvement of Reading road through the village of Reading and in such other locations where necessary, these improvements to be "completed before the date set for the first $30,000 race at the new Speedway on Labor Day, September 4." The commissioners also made a tour of the other roads leading to the Speedway, making notes of sections that needed resurfacing or repairing, and ordering the county engineer to look after these improvements immediately.

Information received by the Speedway officials from various cities and towns on the Dixie Highway bring the information that hundreds of motorists from the north and from the south will tour to Cincinnati for the Speedway race on September 4, and to attend the Dixie Highway Convention and Exposition which will be held at the Cincinnati Music Hall from September 1 to 9.

* * *

Motorists journeying to the opening international sweepstakes race at the new Cincinnati Speedway on Labor Day, September 4, are promised good roads leading to the new track from all parts of Hamilton County. For some months the officials of the Speedway have been consulting with the commissioners of Hamilton County, concerning the roads to be used in reaching the two-mile course, and as a result of these conferences plans now are under way for the improvement of the three highways that lead direct to the track, these being the Springdale track—part of the Dixie Highway—from the western portion of the city; the Reading Road from the central section, and the Montgomery Pike, for the use of those residing in the eastern district of Cincinnati. Work on Reading road, which is most in need of reconstruction, will begin some time next week, and the other highways will receive such attention as they require to make them perfect for motoring some time before the date set for the opening of the track.

* * *

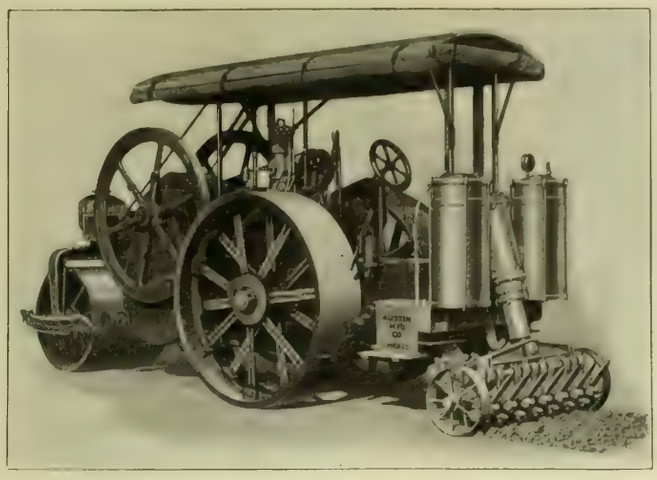
## Old National Road

The three hundred miles from Baltimore or Washington, through Frederick, Hagerstown, Cumberland, Frostburg, and Uniontown, to Wheeling, West Virginia, is the most historic thoroughfare in the United States, and the eastern division of the National Old Trails Ocean-to-Ocean route. For several years it has been studied in detail by Robert Bruce, long on the staff of the American Automobile Association and the Automobile Blue Books, who has just brought out, under the name of "The National Road," a booklet of 100 pages, covering the route from the topographic, pictorial, and historic standpoints. It is the work of a close student of the subject, who has spared neither time nor pains to go beneath the physical features which, however, are brought out with special clearness and good effect, to the stirring history and legend that center about the old turnpike from Baltimore and Washington across the Allegheny Mountains to the Ohio River more than any other single road in America.

The fact that the National Road is now in first-class shape practically all the way from Chesapeake Bay or the Potomac River to the Ohio, and that many tourists are looking for new trips to take the place of their customary European tours, makes

# *The Latest Thing in Road Scarifiers*

***The Austin Motor (Kerosene) Roller has received a further enhancement to its high value as a road builder.***



## The Austin Pneumatic Scarifier Attachment

FOR general maintenance work, no greater labor saving device has ever been placed on a road roller. The Austin scarifier utilizes the weight and power of the roller to tear up old road surfaces in the most approved manner. Its movements are entirely controlled by the power of the engine, the teeth or tynes being pulled direct from the roller main frame, while the device is raised and lowered, quickly and simply, by compressed air supplied to the scarifier cylinder from the tanks on either side of same. The air is compressed by a two-cylinder compressor mounted above the engine cylinder and operated from the engine crank shaft.

### *Important Features:*

The operator can control every movement from his position at the roller steering wheel.
The scarifier does not interfere with the regular working parts of the roller.
It can be attached to any standard Austin 10-ton or larger roller.
Every part is accessible; nothing out of reach or out of sight.
The users of this scarifier attachment have endorsed it as a **perfect machine for the purpose.**

*Write for Our New Scarifier Circular.*

## The Austin-Western Road Machinery Co.

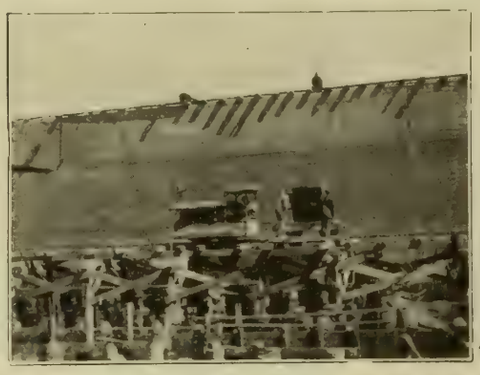
**Chicago, Illinois**

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## Plymouth Gasoline Locomotive Breaks World's Concreting Record On U. S. Dam Work

The Ohio River Contract Co., of Evansville, Ind., not only has broken all the concreting records on the longest movable dam in the world (No. 48, Ohio River), but it has cut them in half by placing 9,810 cubic yards in 269 hours, including all delays, and at the same time saving $44 in cost every 8 hours.



*From a Photo*

**HERE'S WHAT SECRETARY EICHEL SAYS:** "These two 'Plymouths' supplanted 12 mules on this work and each saved us $22 in cost every 8 hours," says Mr. Eichel. "On an 800-ft.-haul the cost per ton mile was $.0761 which is a record in itself. They operated a maximum round trip of 1,600 feet, with stop for loading at mixer and dumping material. Average time for each 'Plymouth' was 4 minutes, day and night, for 22 days, including all delays."

## Plymouth Locomotives Do Wonders in All Sorts of Duties

On construction work—in road building—in mines—in gravel pits—in brickyards—and wherever haulage between two fixed points is a problem. Plymouth Locomotives are working low-cost miracles every day.

**READ EICHEL'S FULL STORY—IT'S FREE TO YOU.** We have a complete record of the concreting work done at Dam No. 48, which was supplied by the Chief Engineer and written by Mr. Eichel himself. It is full of interesting figures for contractors and will be mailed to anyone requesting it. A postcard will bring it.

**THE J. D. FATE CO., 209 Riggs Ave., Plymouth, O.**



# Build Macadam Roads

The macadam road is gaining favor each day.

It is the oldest and best class of road construction in Europe and America.

Thousands of dollars are being spent annually to promote Brick and Concrete Roads, BUT BEAR IN MIND THAT A BRICK ROAD COSTS MORE THAN TWICE AS MUCH AS MACADAM and Concrete increases the cost nearly one-half and neither will wear any longer than a high standard Macadam Road.

Figure the total cost of each road covering a period of twenty years or longer and you will adopt macadam.

Get the facts before adopting your specifications.

Write us for information on stone and slag macadam, water-bound, or treated with asphalt or tar.

We can make delivery of crushed stone or slag in all parts of Northern Ohio, Eastern Ohio, Northern Indiana, and Southern Michigan.

## THE FRANCE STONE CO.

TOLEDO, OHIO

General Office: Second National Bank Bldg

TELL 'EM YOU SAW IT HERE.


the publication of this book most timely. A careful reading of it is likely to convince one that American highways, especially these built along the lines of the old trails between the Atlantic seaboard and the central West or far West, deserve more careful and thorough treatment than they have received in the past. Copies at $1.00 each, postpaid, can be secured from the author, Robert Bruce, Clinton, Oneida Co., New York, who will be glad to correspond with any motorist intending to make all or part of that trip.

* * *

During April the voters in Spencer district, Roane County, West Virginia, approved a $240,000 bond issue for constructing twenty-five miles of concrete roads. Voters in Walton district were not to be outdone, and on May 23 approved a $208,000 bond issue by a two to one majority. This calls for eighteen miles of concrete road.

Roane County built concrete roads in 1914 and 1915 and the voters' determination to continue this policy shows the satisfaction which concrete has given.

* * *

## It Is a Law

(*Continued from page* 3)

contingencies shall not exceed ten per centum of the total estimated cost of the work. If the Secretary of Agriculture approve the plans, specifications, and estimates, he shall notify the State Highway Department and immediately certify the fact to the Secretary of the Treasury. The Secretary of the Treasury shall thereupon set aside the share of the United States payable under this act on account of such project, which shall not exceed fifty per centum of the total estimated cost thereof. No payment of any money apportioned under this Act shall be made on any project until such statement of the project, and the plans, specifications, and estimates therefor, shall have been submitted to and approved by the Secretary of Agriculture.

When the Secretary of Agriculture shall find that any project so approved by him has been constructed in compliance with said plans and specifications he shall cause to be paid to the proper authority of said State, the amount set aside for said project: Provided, That the Secretary of Agriculture may, in his discretion, from time to time make payments on said construction as the same progresses, but these payments including previous payments, if any, shall not be more than the United States' pro rata part of the value of the labor and materials which have been actually put into said construction in conformity to said plans and specifications; nor shall any such payment be in excess of ten thousand dollars per mile, exclusive of the cost of bridges of more than twenty feet clear span. The construction work and labor in each State shall be done in accordance with its laws, and under the direct supervision of the State Highway Department, subject to the inspection and approval of the Secretary of Agriculture and in accordance with the rules and regulations made pursuant to this act.

The Secretary of Agriculture and the State Highway Department of each State may jointly determine at what times, and in what amounts, payments, as work progresses, shall be made under this act. Such payments shall be made by the Secretary of the Treasury, on warrants drawn by the Secretary of Agriculture, to such official, or officials, or depository, as may be designated by the State Highway Department and authorized under the laws of the State to receive public funds of the State or county.

Sec. 7. To maintain the roads constructed under the provisions of this act shall be the duty of the States, or their civil subdivisions, according to the laws of the several States. If at any time the Secretary of Agriculture shall find that any road in any State constructed under the provisions of this act, is not being properly maintained, he shall give notice of such fact to the Highway Department of such State, and if within four months from the receipt of said notice, said road has not been put in a proper condition of maintenance, then the Secretary of Agriculture shall thereafter refuse to approve any project for road construction in said State, or the civil subdivision thereof, as the fact may be, whose duty it is to maintain said road until it has been put in a condition of proper maintenance.

Sec. 8. That there is hereby appropriated and made available until expended, out of any moneys in the National Treasury not otherwise appropriated, the sum of one million dollars for the fiscal year ending June 30, 1917, and each fiscal year thereafter, up to and including the fiscal year ending June 30, 1926, in all, ten million dollars, to be available until expended under the supervision of the Secretary of Agriculture, upon request from the proper officers of the State, Territory, or county for the survey, construction, and maintenance of roads and trails within or only partly within the national forests, when necessary for the use and development of resources upon which communities within and adjacent to the national forests are dependent: Provided, That the State, Territory, or county shall enter into a co-operative agreement with the Secretary of Agriculture for the survey, construction, and maintenance of such roads or trails upon a basis equitable to both the State, Territory, or county, and the United States: And provided also, That the aggregate expenditures in any State, Territory, or county shall not exceed ten per centum of the value, as determined by the Secretary of Agriculture, of the timber and forage resources which are, or will be, available for income upon the national forest lands within the respective county or counties wherein the roads or trails will be constructed; and the Secretary of Agriculture shall make annual report to Congress of the amounts expended hereunder.

That immediately upon the execution of any co-operative agreement hereunder, the Secretary of Agriculture shall notify the Secretary of the Treasury of the amount to be expended by the United States within or adjacent to any national forest thereunder, and beginning with the next fiscal year and each fiscal year thereafter, the Secretary of the Treasury shall apply from any and all revenues from such forest ten per centum thereof to reimburse the United States for expenditures made under such agreement until the whole amount advanced under such agreement shall have been returned from the receipts from such national forest.

Sec. 9. That out of the appropriations made by or under this act, the Secretary of Agriculture is authorized to employ such assistants, clerks, and other persons in the city of Washington and elsewhere, to be taken from the eligible lists of the Civil Service Commission, to rent buildings outside of the city of Washington, to purchase such supplies, material, equipment, office fixtures, and apparatus, and to incur such travel and other expense as he may deem necessary for carrying out the purposes of this act.

Sec. 10. That the Secretary of Agriculture is authorized to make rules and regulations for carrying out the provisions of this act.

Sec. 11. That this act shall be in force from the date of its passage.

* * *

## State Highway Maintenance in Maryland

(*Continued from page* 6)

It is fortunate that the commission has been able to do this, as otherwise the roads that had been completed would have been so neglected that many of them would now be in poor shape, entailing a serious loss to the taxpayers of the State. No provisions whatever were made for maintenance until 1910, when the General Assembly enacted a law which provided that the net receipts of the Motor Vehicle Commissioner, after deducting the expenses of conducting his office, should be distributed as follows:

Twenty per cent. to Baltimore City.

Eighty per cent. to be divided for maintenance between the State roads and the State-Aid roads, the distribution to be on a mileage basis. Under this Act, the following sums have been received and apportioned to January 1, 1916.

ALLOTMENT OF RECEIPTS FROM THE MOTOR VEHICLE COMMISSIONER

| Year | Net receipts from motor vehicle commissioner | Baltimore City 20 per cent. | For maintenance of State roads | For maintenance of State aid roads |
|---|---|---|---|---|
| 1911 | $ 56,209.90 | $11,241.98 | $ 26,576.04 | $18,391.88 |
| 1912 | 62,705.76 | 12,541.15 | 31,304.24 | 18,860.37 |
| 1913 | 144,930.25 | 28,986.05 | 74,613.76 | 41,330.44 |
| 1914 | 190,653.10 | 38,130.62 | 116,889.42 | 35,633.06 |
| 1915 | 295,859.27 | 59,171.85 | 190,344.02 | 46,343.40 |
| Tota's | $750,358.28 | $150,071.65 | $439,727.48 | $160,559.15 |


# Pure Iron
## Old and New

**Purity of Old-time Iron.**

[Springfield Republican] The old Wayside Inn at Sudbury, celebrated by Longfellow, has a new glory to add to its accumulation of fame. Some of the iron nails which had held the original clapboards, and which were 228 years old (the inn having been erected in 1686) were recently extracted and were found to be in almost perfect condition. On being subjected to analysis, they were found to contain but the merest traces of sulphur, carbon, manganese and copper, and herein is the reason why this iron gave such excellent service. It is said that iron of equal purity to the iron manufactured by the old-time puddling process has not been commercially available in recent years, though certain firms assert they have found a process that produces iron equally pure.

The qualities that made the iron of a hundred years ago far and away more durable than modern steel, produce the same results today. These qualities are **purity** and that physical **evenness** which comes from careful and conscientious methods of manufacture.

## "ARMCO" IRON CULVERTS

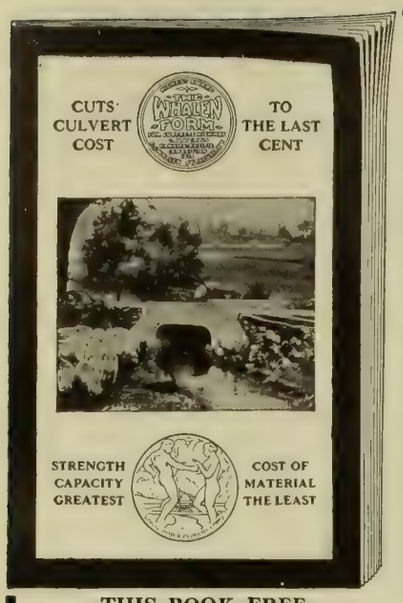
Are made from material which excels in purity and evenness, even the splendid old iron of our grandfathers' time. Experience points to the conclusion that it will give proportionately long service.

For full information as to "Armco" (American Ingot) Iron Corrugated Culverts, Siphons, Flumes, Sheets, Roofing, and Formed Products and for the names of satisfied users, write to

**Armco Iron Culvert & Flume Mfrs.' Association**

Cincinnati Ohio

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THIS BOOK FREE

# PROOF!

YOU Road Builders are, or should be interested in culvert construction. The most vital question in road building today is, NOT what type of material to use for the surface of the road, or what make of machinery to do the work—but **the one biggest thing in all road construction is, or ought to be, Drainage!** How to get the most water across the road at the least expense and through the most permanent structure—is a question worthy of the best of you.

A NEW BOOK HAS BEEN WRITTEN ON CULVERT CONSTRUCTION. And this book is FREE to interested readers of Better Roads and Streets. The man who compiled the information contained in it probably knows more about this subject than any man in America today. Yet it is all given to you **free for the asking.** The only request is that you mention that you saw this ad in Better Roads and Streets The book does not confine itself to theories—but **is full of facts and figures.** Even if you do not agree with all that is written—tho that is not likely—you will still find the book full of intense human interest. **It will open your eyes** —if it does no more. This is not a catalog—it is a free BOOK on the subject of CULVERTS. A cut of the outside front cover is shown above. Now get busy with coupon below.

SALESMEN WANTED FOR

## THE WHALEN FORM

**401 Vinney Building, Syracuse, New York**

**Use Coupon Below at Once and Get Your Copy of This Book Free Today.**

**Fill out and mail today the Coupon below addressed to The Concrete Form Co., Inc., 401 Vinney Bldg., Syracuse, N. Y.**

*Send me at once postpaid, and with no charge or obligation, a copy of your new Culvert Book*

*Name*_____ *Business or Official Title*_____

*Address*_____

## Littleford Tar Heaters

***The Proof of the Heater is in the Heating***



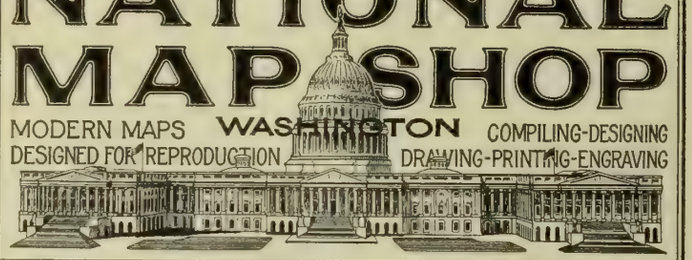
**Built in sizes ranging from 50 to 900 gallons.**

**Especially adapted for road and street construction and maintenance work.**

**Write for Catalog.**

**LITTLEFORD BROS.,** **400 East Pearl Street CINCINNATI, OHIO**

# NATIONAL MAP SHOP




**Attractive maps talk! If you want YOUR map, plat or diagram to get an AUDIENCE, you can't afford to overlook this point. Tell us what you want and let us give estimates and samples. ROAD MAPS FOR BLUE PRINTS OR LINE CUTS A SPECIALTY**

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The maintenance of the Annapolis and of the Washington Boulevards was taken out of the amounts in the column "For Maintenance of State Roads," and as these boulevards were supposed to be maintained out of a special fund, the amount available for the remainder of the State roads was materially reduced.

The Legislature of 1912, upon the recommendation of the governor, provided also for a one cent direct annual State tax for maintenance, but, unfortunately, this tax was not collectible in 1912, and but $30,996.68 was turned over from it in 1913.

There have been received by the State Roads Commission from various miscellaneous sources, such as tolls, charges for forms and permits, rents, interest, etc., certain sums, which have also been placed to the credit of the maintenance fund. The total receipts for maintenance from all sources for State roads, by years, have been as follows:

TOTAL MAINTENANCE RECEIPTS FOR STATE ROADS

| Year | From motor vehicle commissioner | From the one cent. State tax | From miscellaneous sources | Total receipts |
|---|---|---|---|---|
| 1911 | $ 26,576.04 | | $ 39,031.99 | $ 96,912.27 |
| 1912 | 31,304.24 | | | |
| 1913 | 74,613.76 | $30,996.68 | 16,878.65 | 122,489.09 |
| 1914 | 116,889.42 | 95,301.24 | 19,248.81 | 231,439.47 |
| 1915 | 190,344.02 | 95,893.02 | 39,106.62 | 325,343.66 |
| Totals | $439,727.02 | $222,190.94 | $114,266.07 | $776,184.49 |

The total maintenance expenditures on State roads during the above period, by years, have been as follows:

| | |
|---|---|
| 1910 and 1911 | $ 88,676.23 |
| 1912 | 127,154.63 |
| 1913 | 249,733.43 |
| 1914 | 309,503.98 |
| 1915 | 379,028.20 |
| Total | $1,154,096.47 |

Since there has been received for maintenance the sum of $776,184.49 since and including 1910, and expended during the same period the sum of $1,154,096.47 for the maintenance of the State roads, there is an apparent deficit of $377,911.98. This deficit however, is only apparent, and is much larger than the real deficit, for the reason that the fiscal year of the State Roads Commission ends with the calendar year, whereas the fiscal year of the Commissioner of Motor Vehicles ends April 1, when he turns over to the State Treasurer the money for his preceding year due to the State Roads Commission for maintenance, and the one cent State tax is payable to the State Roads Commission semi-annually, as collected, on January 1 and on July 1. The result of this is, that the expenditures for maintenance given for 1915 are for the calendar year ended December 31, 1915, against which there should be an estimated balance or credit of $180,000 for the amount due, but which was not payable until April 1, 1916, from the motor vehicle receipts, and also $62,000 for the semi-annual receipts from the tax levy for the six months from July 1, 1915, to December 31, 1915, but which is not payable until the following day, that is, January 1, 1916. This makes a total credit of $242,000 to the commission on December 31, 1915, but which was not available then because of the difference in the dates of the fiscal years. This would then reduce the total apparent deficit of $378,000 by $242,000, to $136,000, which represented the real deficit on December 31, 1915, for the full eight-year term of the commission.

The commission in 1913 recommended to the General Assembly that the tax on motor trucks and on motorcycles be increased, and prepared with great care a bill for that purpose. This bill was introduced in the Legislature, but was not passed by that body. Had the recommendations as set forth in that bill been carried out, it would have brought in an additional revenue of about $55,000 in 1914 and 1915, which would still further have reduced the deficit on maintenance to about $81,000. Had provision also been made for the maintenance of the old bridges and of the turnpikes that had not then been reconstructed, this entire deficit would have been practically wiped out.

It is estimated that the receipts which will be available for maintenance this year will amount to $410,000, of which




*Illustrating Our Sign in Use on the Cluster Light Standard in Front of City Hall, of Columbus, Ohio*

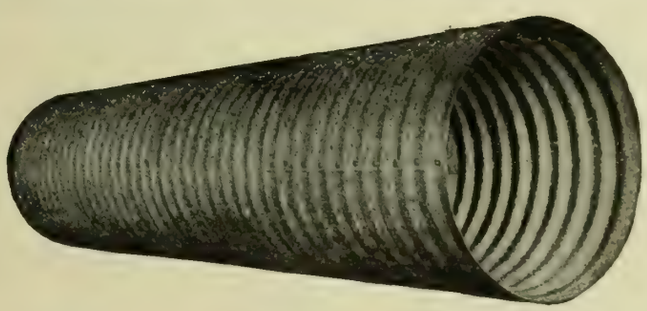
OUR GUARANTEE

A sign, the legibility of which, cannot be destroyed by the most severe bending or striking test. A sign that is guaranteed against the cracking or breaking or deterioration from rust for a term of thirty years, on which the lettering never needs renewing. A sign on which the surface coating of the lettering and the surface finish of the plate may be renewed without removing the sign from the standard. A sign which can be refinished and made as good as new at any time at a cost not exceeding 20 per cent. of the original purchase price.

*Send for Our Booklet and Testimonials*

**The Indestructible Sign Co.**

**61½ Prescott Avenue** **COLUMBUS, OHIO**



# Wheeling Metal Culverts

Such abstract expressions as "quality," "durability," and "economy" are so overworked that the road builder sees in them but an arrangement of meaningless letters, until he has had experience with Wheeling Corrugated Metal Culverts. Then their significance is so readily understood, it is highly improbable that he ever forgets to specify "Wheeling" when he needs culvert pipe; it makes the road appropriation go further.

**And Wheeling Culverts are made of galvanized Portsmouth Iron even to such details as the rivets.**

Just say "prices" to the nearest address.

**WHEELING CORRUGATING COMPANY, WHEELING, W. VA.**

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8 to 48 inches diameter, 3 and 4 ft. lengths. Half sections which lock with lugs.

Provides for expansion and contraction. Easy to handle and lay in ditch. Requires less excavation. Strong and durable. Send for Catalog "F" giving full description of complete line.

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# Mogul and Titan Tractors Operate on Kerosene and Other Low-Priced Fuels



Years ago the makers of Mogul and Titan tractors realized that if there was to be cheap power for building roads, it must come from the lower priced fuels—not from gasoline. Accordingly, the keenest inventive minds and the best skill obtainable were put to the task of designing tractors that would use kerosene as well as or better than other tractors operate on gasoline and at the same time do the most reliable work. The Mogul and Titan kerosene tractors are the successful result as experienced road commissioners and contractors know.

That is why you will find in every section of the country today, wherever highways are being bettered, International Harvester tractors in the following sizes, rendering uniform lasting good service: MOGUL 8-16 H.P., TITAN 10-20 H.P., MOGUL 12-25 H.P., TITAN 15-30 H.P., and TITAN 30-60 H.P.

Possibly your road maintenance costs are higher than they need be. Perhaps a little investigation would pay. Would you like to see some of the figures we have collected—some of the savings we have helped other contractors and road builders to make by changing over to Mogul or Titan kerosene tractor power? They'll cost you nothing but a two-cent stamp and a little time. Write for them.

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$305,000 will come from the Commissioner of Motor Vehicles and $105,000 from the one cent State tax. It is anticipated that the maintenance expenditures will amount to $450,000, which will leave a deficit this year of $40,000. The amount expected from the Commissioner of Motor Vehicles is based upon the assumption that the present Legislature will increase the tax on motor trucks, motor busses, and motorcycles.

The estimated maintenance receipts for 1917 are $497,000, of which it is anticipated that $387,000 will be received from the Commissioner of Motor Vehicles and $11,000 from the one cent State tax. The expenditures for 1917, it is also estimated, will be $500,000, which will leave a deficit of $3,000.

* * *

## Drainage and Foundation Problems Due to Soil and Other Geological Conditions

(*Continued from page* 8)

first be built and vegetation started on the surface of the slopes as soon as possible to prevent erosion.

As a final part of the discussion, it is necessary to consider the construction of bridges and culverts for streams and water courses crossing the road. In the first place, any bridge or culvert which is constructed, should be built permanently. Therefore, their foundations should be adequate; they should be large enough to carry off all the water delivered in times of flood, and should be erected at the proper points for the accommodation of water-courses with the least possible interruption to stream flow.

In connection with the proper design of bridges and culverts, greatest care should be taken in the construction of the foundation of the side or end walls, either of the bridge or culvert. They should be carried to sufficient depth to prevent scour from the streams passing through the bridge or prevent damage from heaving due to frost action.

The width of the foundation should be sufficiently great not to unduly load the earth beneath and to transmit the weight from the bridge through the foundation to this earth.

The area of waterway should be carefully computed and checked with all available data which may be secured. The use of empirical formulae for the approximation of the area is proper but must be considered as final.

Recommendation is made of the use of Myer's formula where the area of waterway in square feet equals the square root of the drainage area in acres multiplied by a constant. This constant varies with the condition of the surface of the drainage area being assumed as one (1) in the case of flat country; two (2) in the case of rolling; three (3) in the case of hilly country, and four (4) for mountainous country. This formula is, however, only a rough approximation for the determination of waterway area and additional information should be sought as follows:

Investigation should be made of existing bridges, both up and down stream, from the location where a structure is to be designed and inquiry instituted in the locality to secure opinion as to the adequacy of the existing waterways and the occurrence previously of severe floods which might have overtaxed the bridges in question. It might possibly occur at times also in the investigation of bridge designs and locations, that the existing waterway might be considered as too large and economy effected in this way, although this is not often the case nor very safe action to take.

In computing the area of waterway necessary, use can be made of the topographical sheets issued by the United States Geological Survey, so that the area of the water-shed can be easily obtained without extended field work.

In investigating the installation of surface water structures, that is, bridges and culverts, it is always well to determine whether a relocation of the structure may not be made in such a manner as to combine two or more bridges or in such a manner as to obviate the construction of any bridge by the relocation of the stream.

In further consideration of bridge abutments, it is always necessary in constructing high abutments, to consider the methods of back filling behind the abutments and the proper drainage of such back filling through the abutments to waterways, particularly in the case of abutments known as the "U"

type. The filling should be of a porous character placed in layers and thoroughly compacted with some sort of blind drain leading to weep holes through the abutment.

As an indication of what damage will result from the failure to carry out these suggestions, the speaker is reminded of an abutment built some years ago on the line of one of the Connecticut railroads where a track depression was being made and the abutment was built to final grade before the excavation for the new tract was carried out. The local material was clay and the filling for the abutments was secured by excavating for the track depressions and placing the excavated material behind the abutment after completion. The abutments were well designed, extremely strong and of sufficient thickness to carry the filling, if it had been properly placed, but the material was excavated in the winter time and frozen in large chunks and the work was interrupted several times on account of heavy storms. No provision was made either for draining the filling or for allowing the water to leak through the abutment by means of weep holes and the consequence was that the heavy frost laden filling became practically a liquid mass in the spring of the year and caused the abutment to slip forward some fifteen (15) or twenty (20) feet, breaking it in vertical joints at the angles of the "U." While the abutment might have held this liquid filling if it had been made heavy enough, the proper drainage of the back filling would have secured the work against failure.

In conclusion it might be said that while the subject of drainage is the simplest and most easily treated of the problems which enter into the construction of proper highways, it is never given the attention that it merits. Highway engineers preach continually of the value of proper drainage and foundation studies, but seldom make them. There are few roads constructed by engineers which are entirely successful from the standpoint of drainage. A great many roads have been built even with the most careful study, which have shown weakness from time to time due possibly to unknown conditions and possibly to the lack of attention in discussing and constructing the foundation and the drainage therefrom. It might, therefore, well be said that while the problem is simple, the results of lack of care are far reaching and the most serious damage may be caused by carelessness or lack of knowledge.

No matter how much study the highway engineer may give to drainage and foundation problems, he may be assured that some time or other in his work he will make a failure. Consequently no effort should be spared in the consideration of this most important topic.

* * *

## New Specifications for Portland Cement

(*Continued from page* 9)

experience, so that the facts of yesterday become the faults of to-day. Of all of the ingredients of concrete, cement suffered least in this increasing knowledge, but it did suffer somewhat, and demands grew that the standards of purchases be changed to meet the new knowledge.

Unfortunately certain elements in the cement committee—elements made up not wholly, though largely, of the manufacturing interests—adopted an uncompromising Bourbonism. They resented change; they maintained through several years that not only had 50,000 or 60,000, or at least 100,000 copies of the old specifications been distributed—of course an unanswerable argument for the specification—but that the standards set by that specification were the best conceivable for this or all time. With only minor retreats from this uncompromising position, the cement committee stood for eight years until it was forced into a revisionary attitude by the promulgation of a separate Government standard and the loss of the prestige not only of Government sanction but of universal acceptance. The revision at this meeting is but tardy recognition of long standing constructive criticism

"The lessons of the past ten years should not be lost on the cement committee of the American Society for Testing Materials. Nothing could be further from the desirable than a constant annual shifting to meet the local winds of research and opinion, but a due respect for the developments of the art is incumbent. Science and engineering have no place for the precept 'Whatever is, is right.'"





The original and only Elastite Joint

**On Dixie Highway**

Engineers in charge of this great concrete roadway connecting the Northern and Southern boundaries of the United States, used Carey Elastite Expansion Joint.

The result is a magnificent, smooth, permanent surface.

On the finest streets and roadways everywhere ELASTITE is specified because it is the *Modern Way* of providing for surface expansion. Does away with old-fashioned tar and kettle gang with its laborious, tedious methods.

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**Seventy-Eight Huber Rollers in Seven Counties That is the Record of the Huber Roller in Ohio**

Seventeen Huber rollers are solving the good roads problem in Seneca County. There are a half dozen or more Hubers in many other counties, doing the same work. Four contracting firms in Elyria, own NINE Huber rollers.

**HUBER STEAM ROAD ROLLERS AND SCARIFIERS**

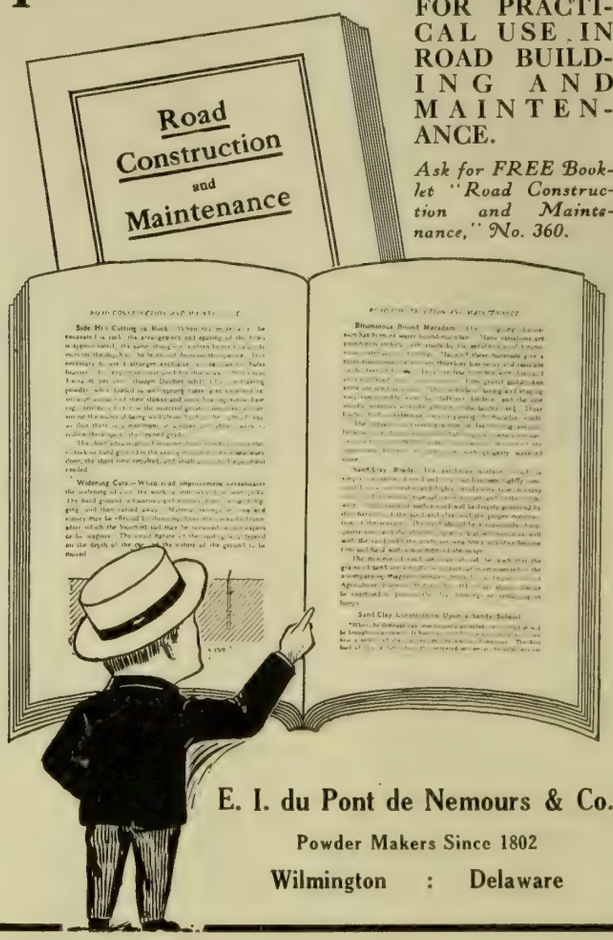
Are being used by hundreds of up-to-date contractors, city, township, and county officials. One large contractor in Ohio, who owns two Huber rollers and a couple of other makes, states that he prefers a Huber on account of its easy steaming qualities, abundance of power and freedom from large and expensive repair bills.

We will be pleased to give you full data as well as quote prices on your requirements, if you will drop us a line. Remember, the original Steam Scarifier is found only on a Huber roller.

THE HUBER MANUFACTURING COMPANY
Steam Road Rollers, Scarifiers, Traction Engines, and Gas and Oil Tractors
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Powder Makers Since 1802
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TELL 'EM YOU SAW IT HERE.

The new Portland cement specifications are as follows:

1. Portland cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion an intimate and properly proportioned mixture of argillaceous and calcareous materials with no additions subsequent to calcination excepting water and calcined or uncalcined gypsum.

### 1. CHEMICAL PROPERTIES

2. The following limits shall not be exceeded:

| | |
|---|---|
| Loss on ignition, per cent | 4.00 |
| Insoluble residue, per cent | 0.85 |
| Sulphuric anhydride, per cent | 2.00 |
| Magnesia, per cent | 5.00 |

### 2. PHYSICAL PROPERTIES AND TESTS

3. The specific gravity for cement shall be not less than 3.10 (3.07 for white Portland). Should the test of cement as received fall below this requirement, a second test may be made upon an ignited sample. The specific gravity test will not be made unless specifically ordered.

4. The residue on a standard No. 200 sieve shall not exceed twenty-two per cent. by weight.

5. A pat of neat cement shall remain firm and hard, and show no signs of distortion, cracking, checking, or disintegration in the steam test for soundness.

6. The cement shall not develop initial set in less than forty-five minutes when the Vicat needle is used, or sixty minutes when the Gillmore needle is used. Final set shall be attained within ten hours.

7. The average tensile strength in pounds per square inch of not less than three standard mortar briquettes composed of one part cement to three parts standard sand, by weight, shall be equal to or higher than the following:

| Age at Test, Days | Storage of Test Pieces | Tensile Strength Pound per Square Inch |
|---|---|---|
| 7 | One day in moist air and six days in water | 200 |
| 28 | One day in moist air and twenty-seven days in water | 300 |

8. The tensile average strength of standard mortar at the age of twenty-eight days shall be higher than the strength at seven days.

### 3. PACKAGES, MARKING AND STORAGE

9. The cement shall be delivered in suitable bags or barrels with the brand and the name of the manufacturer plainly marked thereon, unless shipped in bulk. A bag shall contain ninety-four (94) pounds net. A barrel shall contain three hundred and seventy-six (376) pounds net.

10. The cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment, and in a suitable weather-tight building which will protect the cement from damages.

### 4. INSPECTION

11. Every facility shall be provided the purchaser for careful sampling and inspection at either the mill or at the site of the work, as may be specified. At least ten days from the time of sampling shall be allowed for the completion of the seven-day test, and at least thirty-one days for the twenty-eight-day test. The cement shall be tested in accordance with the methods hereinafter prescribed. The twenty-eight-day test shall be waived only when specifically ordered.

### 5. REJECTION

12. The cement may be rejected if it fails to meet any of the requirements of these specifications.

13. Cement shall not be rejected on account of failure to meet the fineness requirement if upon retest after drying at one hundred degrees centigrade for one hour it meets this requirement.

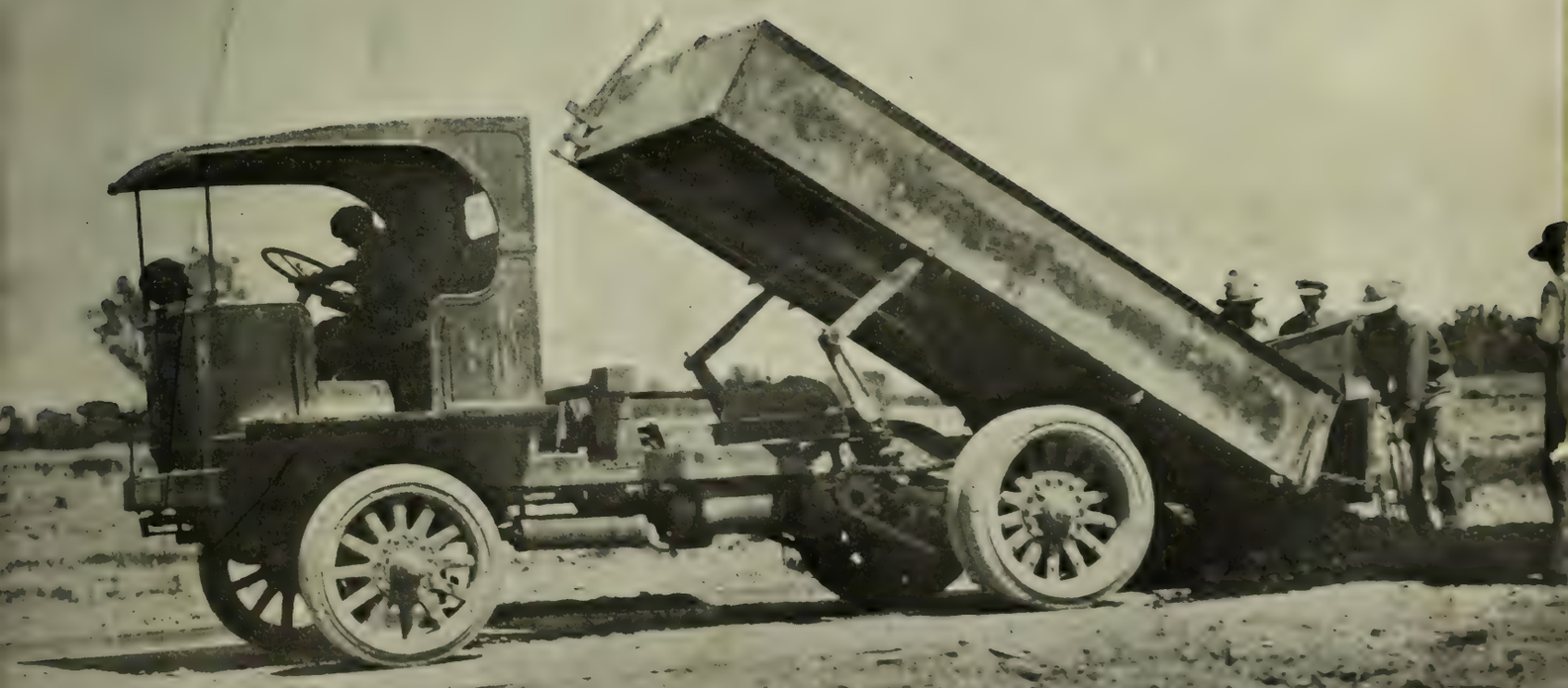
14. Cement failing to meet the test for soundness in steam may be accepted if it passes a retest, using a new sample at any time within twenty-eight days thereafter.

15. Packages varying more than five per cent. from the specified weight may be rejected; and if the average weight of packages in any shipment, as shown by weighing fifty packages taken at random, is less than that specified, the entire shipment may be rejected.

(These specifications will be continued and concluded in the September issue of Better Roads and Streets.)

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# BETTER ROADS AND STREETS



SEPTEMBER, 1916.




Garford

Motor Trucks

# Here's Another Example of Garford Stamina

The W. J. Newman Company of Chicago is using three big 6-ton Garford Motor Trucks.

On a recent excavating job these three Garfords carried away over 12,000 cubic yards of dirt and stone in 18 days.

The trucks were worked day and night, and through considerable rainy weather.

Yet the job was finished two days ahead of contract time — and was finished economically.

It was Garford stamina, Garford endurance, Garford downright efficiency that made such a record possible.

More and more hard-headed business men are recognizing these Garford characteristics every day.

And more and more Garford Motor Trucks are constantly being put to work — difficult work.

Garfordize ***your*** business. Put a faithful Garford servant at work on ***your*** hauling problems and you 'll find it worthy.

Whether your business is large or small, whether you need a light truck or one of heavy capacity, there is a Garford to meet your requirements.

We are familiar with trucking problems of all kinds — ***your*** problems.

And information will be gladly furnished you. Write for catalogs and descriptive literature.

Please address Dept. 100.

## The Garford Motor Truck Company, Lima, Ohio

**Manufacturers of Trucks of 1, 1½, 2, 3½, 5 and 6-ton capacity. 4½, 7 and 10-ton Tractors.**

# Better Roads and Streets

VOL. VI. NO. 9 SEPTEMBER, 1916 PRICE FIFTEEN CENTS

## Federal Road Co-operation with the States

Special Conference Called for the Discussion of the Tentative Rules and Regulations of the Secretary of Agriculture under the Federal Aid Road Act by the Office of Public Roads and Rural Engineering and the State Highway Officials of the United States

A CALL was sent out by Logan Waller Page, director of the Office of Public Roads and Rural Engineering, to all State highway officials of the various States of the United States to meet in Washington on Wednesday, August 16, to discuss the Tentative Rules and Regulations of the Secretary of Agriculture under the Federal Aid Road Act. The conference was one of the greatest importance to the road officials of every State in the country, and the result was that, on Tuesday and Wednesday, there was gathered in Washington the largest and most representative gathering of State highway officials that ever arranged to meet and get together.

The meeting was called to order at ten o'clock Wednesday morning by Logan Waller Page, director of the Office of Public Roads and Rural Engineering, with J. E. Pennybacker, chief of the Bureau of the Economics of the Office of Public Roads and Rural Engineering acting as secretary. The meeting place was the auditorium of the beautiful new National Museum. Secretary Pennybacker called the roll of the States, and a complete list of the highway officials who were present will be found at the conclusion of this account of this important meeting.



LOGAN WALLER PAGE
Director, Office of Public Roads and Rural Engineering, Washington, D. C.

Director Page, in a brief address, stated that one of the main intents of the Federal Aid Act is to give the several States more authority over the roads and in road matters, and stated the position of the United States Government by saying that it desires, through the Office of Public Roads and Rural Engineering, to co-operate with the States in every way possible, so far as it is practical to do so. Inasmuch as this is the first time that the Federal government has ever co-operated directly with the States in highway construction, it was admitted that there would be a great many points which would come up which would have to be straightened out, and that it was for this reason that the highway officials had been called to Washington to discuss the tentative rules and regulations for the governing of the work under the act. As will be noted on another page of this issue of BETTER ROADS AND STREETS, the officials had held a meeting at the Raleigh Hotel on the day previous, when the rules and regulations were gone over and changes suggested. All of these proposed changes, with two exceptions, had been unanimously favored by the highway officials in session. It is not the intention to present in this account of the meeting the detailed rules and regulations for the reason that those proposed were merely tentative, and, although the changes have been voted on favorably by the association of State Highway Officials of the United States, this must not, under any circumstances, be taken to mean that such changes have been made and accepted by the United States Department of Agriculture. Such is not the case. The changes will all be considered by the proper officials of the Office of Public Roads and Rural Engineering, and will then be submitted to the Secretary of Agriculture for final acceptance or rejection. Many important changes were recommended by the Association of State Highway Officials of the United States, and it is generally recognized that, as most of them are of an excellent nature and character, they will ultimately be written into the final rules and regulations.

The rules and regulations were read, section by section, by Secretary Pennybacker, changes as proposed by the State highway officials being read and explained by Henry G. Shirley, president of the Association of State Highway Officials. Further discussion and changes were then asked for by Director Page. A stenographic record of the entire discussion was taken, and this will be placed before the Secretary of Agriculture for his guidance in his final disposition of the proposed changes. No action of any kind was therefore taken on the changes as proposed, either in open discussion at this meeting or as decided upon at the meeting the day before.

The discussion on some of the subjects was of the highest order, as would be expected coming from the highly experienced engineers who were present. As an instance, there is the case of the width of the right-of-way on roads that are to be improved by Federal Aid. The engineers present generally favored a wide right-of-way, from sixty to one hundred feet, allowing plenty of room for the construction of wide roadways in the future if it should be found that increased width is necessary, and also to provide for ample side drainage, the planting of shade trees, etc. There were some present, however, who preferred to stick to the narrow right-of-way minimum of thirty feet. During the course of this discussion, Director Page explained that in such cases and on such points it is the intention of the Federal government to deal with particular cases and not to adopt any positive rule that will apply to all States and on all Federal-aid roads. He stated that the Government is opposed to the purchase by the Government of any right of way or property to which the Government can get no title whatever. In this attitude, the Government is unquestionably taking the proper stand, as in every case the right of way should be furnished by the State which is participating in Federal aid. The representatives of quite a few of the States have their respective laws on rights of way.

There was also much discussion over the regulation regarding the payment of all costs for engineering on Federal-aid roads after the Secretary has accepted and approved a project, some of those present claiming that this should all be borne by the State accepting the Federal aid, while others claimed that this expense, which includes all engineering surveys and supervision after the project has been approved and accepted by the Secretary of Agriculture, should be deducted from the Federal-aid fund and from the amount that is matched against this fund by the States themselves. It was stated by several of the officials that they do not have the funds to prepare elab-

orate plans, specifications, etc., as are even now prepared by the Office of Public Roads and Rural Engineering.

Secretary of Agriculture Huston arrived at the meeting, and after hearing some of the discussion, was introduced by Director Page and in an excellent address explained his attitude and the attitude of his office as regards the distribution of Federal aid.

Secretary Huston said that the Department of Agriculture wants to save all possible trouble and inconvenience by co-operating fully with the States. The law, he said, recognizes the value of this co-operation and insists upon it, and is one of the very few really co-operative laws that have ever been passed, as most laws of a supposedly co-operative nature only cause friction. There must not, however, be friction under this Federal Aid Act.

The Secretary then explained, as he saw it, the great importance of good roads and the improvement of the roads, their value to any community and their effects upon the schools, farms, markets, and rural life in general. He stated that the one great trouble is that many do not give any consideration to what the bad roads are costing them, for this cost is in nearly every instance much more than would be the cost of well-constructed good roads.

Secretary Huston said that he is in favor of putting the money made available, $85,000,000, into road improvement where it is really needed, and that this will mean the careful consideration and selection of the routes which are to be improved, and that there will be the best possible skill used in the planning and the construction of these roads. The same will also apply to the maintenance of the roads after they are completed, but this work will be entirely in the hands of the State in which the road is built.

Mr. Huston stated that the general public is to-day rather suspicious of experts, and that this suspiciousness has been caused by the fact that so many pose as experts who are not experts at all. The Federal Aid Act will, however, cause the States to get trained and capable engineers, as such will be necessary owing to the fact that all plans, specifications, contracts, etc., must be prepared by the States and submitted to the Office of Public Roads and Rural Engineering to be examined and checked, and then, if satisfactory, sent by that office to the Secretary of Agriculture for final approval and acceptance. In this latter office, all plans, specifications, contracts, etc., will be carefully examined by experts. The department does not want any piecemeal road-building.

It was stated that where a State has no highway department or where it does not engage in any highway work, the counties, if they so desire, can participate in the Federal aid through the State, but that the Federal government will not in any case recognize the individual counties in any way whatever. It is the duty of the States to agree with the final rules and regulations and general plans of the Federal government in all this work, and to take up all work proposed, etc., with the Office of Public Roads and Rural Engineering.

Mr. Huston then took up the question of roads in the National forests, for which there is included in the appropriation the sum of $1,000,000 a year for the next ten years for the construction and improvement of roads and trails. He asked the highway officials of the Western States, in which practically all of these forests are located, to pay particular attention to this work, and to assist in their improvement as much as possible.

In conclusion, Secretary Huston said that he will do everything in his power to facilitate the proper execution of the State officials' duties, and in turn asked for the full, generous and efficient co-operation on the part of the various State highway departments.

At the conclusion of the address by the Secretary of Agriculture, the Association of State Highway Officials of the United States unanimously passed a resolution thanking the Secretary of Agriculture and the Director of the Office of Public Roads for their consideration in summoning them to Washington for the hearing, which had proved to be of inestimable value to every one of them, and which had cleared up many doubtful points regarding the rules and regulations regarding the use of the Federal-aid money.

The meeting was concluded by Director Page stating that in applications by the States for Federal aid, the most important roads carrying the greatest loads of farm products and manufactures be considered when the application is made. He also stated that the department does not want the roads to be too widely scattered, as it makes it very hard for the proper authorities to inspect such roads, and that after they are completed, it makes it a difficult proposition for the States to maintain them.

In the afternoon, the highway officials of the States in which there are forest reserves, met with A. F. Potter, of the Forest Service, at 930 F. Street, when the plans of the Forest Service as relate to Federal aid roads were gone over, and the rules and regulations prepared for the construction of such roads were thoroughly gone over and discussed.

At this meeting, it was announced that the Forest Service will co-operate with the counties and States through the latter, and that roads will be built through the national forests provided the States will build their highways to a point where such highways will connect with those through the forests. This was agreed upon by the various State highway officials who attended the meeting.

The tentative rules and regulations are not published in this account of the conference, owing to the fact that they are not final, that a large number of changes were proposed, many of which were of such value that they will be incorporated in the final rules and regulations, and for the reason that to publish even a synopsis of these tentative rules and regulations might be taken as misleading by some of our readers.

The complete list of State highway officials present at the conference, classified by States, is as follows:

*Alabama*—Robert E. Spragins, chairman of the Commission; W. S. Kellar, State Highway Engineer; Capt. John Craft and G. N. Mitcham, members of the Commission.

*Arizona*—Lamar Cobb, State Engineer; E. P. Adams, chief clerk.

*Arkansas*—W. B. Owen, chairman of the State Highway Commission; H. R. Carter, State Highway Engineer.

*California*—Austin B. Fletcher, highway engineer.

*Connecticut*—Charles J. Bennett, State Highway Commissioner.

*Florida*—Edward Scott, chairman of the State Highway Commission—William F. Cocke, State Highway Commissioner; F. O. Miller, member of the Commission.

*Idaho*—E. M. Booth, State Highway Engineer.

*Illinois*—S. E. Bradt, member of the Highway Commission; W. W. Marr, chief engineer of the Commission.

*Indiana*—The State has no highway department, but Carl G. Fisher was specially appointed to attend the conference by the Governor.

*Iowa*—F. R. White, road engineer.

*Kansas*—W. S. Gearhart, State Highway Engineer.

*Kentucky*—Rodman Wiley, State Highway Commissioner.

*Louisiana*—W. E. Atkinson, State Highway Engineer.

*Maine*—P. J. Deering, chairman of the State Highway Commission; Paul D. Sargent, chief engineer of the Highway Commission.

*Maryland*—Henry G. Shirley, chief engineer of the State Roads Commission.

*Massachusetts*—Col. W. D. Sohier, chairman of the Highway Commission; Arthur W. Dean, chief engineer.

*Michigan*—Frank F. Rogers, State Highway Commissioner.

*Minnesota*—John H. Mullen, road engineer.

*Mississippi*—J. M. McBeath, chairman of the State Highway Commission; X. A. Kramer, State Highway Engineer; D. W. Robbins, member of the Commission.

*Montana*—George R. Metlen, State Highway Engineer.

*Nebraska*—George E. Johnson, State Engineer.

*New Jersey*—Col. Edwin A. Stevens, Commissioner of Public Roads; Robert A. Meeker, State Highway Commissioner; Roy Mullen, division engineer.

*New Mexico*—James A. French, State Engineer.

*New York*—Edwin A. Duffy, State Commissioner of Highways; Irving J. Morris, secretary of the Commission of Highways.

*North Carolina*—Dr. Joseph Hyde Pratt, State Geologist; W. S. Fallis, State Highway Engineer; Col. Benneham Cameron, chairman of the State Highway Commission; Dr. W. C. Riddick, G. C. Roberts, T. F. Hickerson, members of the State Highway Commission.

*Ohio*—Clinton Cowen, State Highway Commissioner; C. H. Duncan, Assistant Attorney-General; W. A. Alsdorf, Secretary of Ohio Good Roads Federation.

*Oklahoma*—Houston B. Teehee, chairman of the Highway Commission; L. R. Cunningham, State Engineer.

*Oregon*—John H. Lewis, State Engineer.

*Pennsylvania*—William D. Uhler, chief engineer of the State Highway Department; W. R. D. Hall, Statistician.

*Rhode Island*—William C. Beckham, member of the State Highway Commission; Irving W. Patterson, chief engineer.

*South Dakota*—E. C. Issenhuth, chairman of the State Highway Commission.

*Tennessee*—Arthur Crownover, chairman of the State Highway Commission; A. M. Nelson, State Highway Engineer; J. J. Murray, secretary of the State Highway Commission.

*Vermont*—S. B. Bates, State Highway Commissioner.

*Virginia*—George P. Coleman, State Highway Commissioner.

*West Virginia*—A. D. Williams, Chief Road Engineer; Joseph Biers, Engineer of Tests; C. W. Bennett, Assistant Engineer of Tests.

*Office of Public Roads and Rural Engineering*—Logan Waller Page, director; P. St. John Wilson, assistant director; J. E. Pennybacker, chief of the Bureau of Economics; M. O. Eldridge, E. W. James, O. L. Grover, Prevost Hubbard, C. S. Reeves.

* * *

## Special Meeting of the Association of State Highway Commissioners of the United States

THE Association of State Highway Commissioners of the United States held a special meeting at the Raleigh Hotel, Washington, D. C., on Tuesday, August 15, President Henry G. Shirley, chief engineer of the Maryland State Roads Commission, presiding. Dr. Joseph Hyde Pratt, of Chapel Hill, S. C., is secretary of the association, and served in that capacity. There was a larger number of State highway officials present at the meeting than has ever before attended the meetings of this important organization, as only about eight or nine States were not represented.

The principal object of the meeting was to go over and discuss the Tentative Rules and Regulations of the Secretary of Agriculture under the Federal Aid Act, which had been sent out to them by the Office of Public Roads and Rural Engineering for preliminary study, and which were to be taken up at a meeting called for the following day by Logan Waller Page, director of the Office of Public Roads and Rural Engineering.

The meeting was considered of the greatest importance, and one step that was taken is, without doubt, the most important of the kind that has ever occurred in the field of highway engineering. This was the resolution that was proposed by W. D. Uhler, chief engineer of the Pennsylvania State Highway Department. The resolution was unanimously carried.

This resolution requested that the chair appoint a special committee to act in conjunction with the Office of Public Roads and Rural Engineering in the formation of a complete and up-to-date set of standard plans, specifications, and forms for the construction and maintenance of Federal aid roads, and that full power to act be given this committee without reserve. The motion and the resolution had the full support of the Office of Public Roads and Rural Engineering, and the vote in its favor was vociferous and unanimous.

The chair appointed W. D. Uhler chairman of this committee, and Arthur W. Dean, chief engineer of the Massachusetts State Highway Commission, and W. W. Marr, chief engineer of the Illinois State Highway Commission as members. The Office of Public Roads and Rural Engineering designated Capt. P. St. John Wilson, assistant director, as its member.

This committee is one of the most capable that could possibly have been selected, and will, without question, fill a long-needed want in highway engineering. Every member of the committee is a highway engineer of the highest standing, and it is certain that the set of standard plans, specifications, and forms that will be prepared will be of the highest order. The importance of this move will be appreciated by our readers when we state that there is not, to-day, in the entire country, a single recognized set of standard plans, specifications, and forms for highway construction and maintenance. Every State, every county, and every city prepares its own set of standards, copied more or less after those of leading States, notably New York, Pennsylvania, Iowa, and California, but none of which are alike or even approaching standard. When these standards which will be prepared and issued by this committee are completed and issued, therefore, there is little question but that they will be likewise adopted by nearly every State, county, and city in the country, as they will include all the best of all the States and that which four of the best road engineers in the country can produce.

There were quite a number of changes agreed upon by the association as considered desirable by the members to be made in the Tentative Rules and Regulations of the Secretary of Agriculture under the Federal Aid Road Act. All excepting two of these changes were unanimously favored. There was considerable discussion over the section which prohibited the use of any patented or proprietary material, specification, process, or type of construction, and this was finally amended by the association by adding a sentence, "unless the work is open to actual competitive bidding." These changes as made are not to be construed as final and to be accepted, however, as they will all be placed before the Secretary of Agriculture for final disposition, following which disposition a revised and final set of rules and regulations will be issued and sent to the proper authorities of every State. A synopsis of these rules and regulations will be found in the account of the meeting called by the Office of Public Roads and Rural Engineering, and it is again the writer's desire to impress upon the readers that this synopsis itself is merely tentative and is subject to further revision and change, although it is probable that many of the recommendations of the Highway Officials' Association will be favorably considered.

The Office of Public Roads and Rural Engineering made it clear that it does not wish to hamper any well-organized and efficient State highway department, but that the intention is to hold any poorly organized or inefficient departments up to the proper standards at all times and thereby secure the best possible work and at the same time to force the raising of the standard of any inefficient highway department, if there be any.

The officials who were present (and as has already been stated, there were but few States with highway departments which were not represented) showed a disposition to do everything in their power to solve the problems that are certain to arise in the beginning in the construction of highways by Federal aid. Every official present showed a willingness and desire to co-operate to the fullest extent with the Federal officials, and this is taken as an indication that there is going to be little or no real friction in working out the final details. It is not, of course, expected that everything will run along like well-oiled machinery at the beginning, for, like any new proposition, it must be tried out, and where defects are found, or where improvement can be made in the method of carrying on the joint work, this will certainly be done.

The meeting in Washington was not the regular meeting of the association, but a special meeting called for the purpose already explained, and no regular business of any kind was taken up. The regular annual meeting of the Association of State Highway Officials of the United States will be held in St. Louis, Mo., December 5 to 7, inclusive.

* * *

## Report of Committee D-4 on Road Materials, American Society for Testing Materials

*(Concluded from July issue)*

REPORT OF THE SUB-COMMITTEE ON THE PENETRATION OF BITUMINOUS MATERIALS

The following report is submitted on behalf of the Sub-Committee on the Penetration of Bituminous Materials, covering its work during the past year:

At the last annual meeting, this sub-committee presented a report including as its chief feature a Proposed Test for Penetration of Bituminous Materials. At the subsequent meeting of Committee D-4, this report was accepted simply as one of progress, and the proposed test was referred back to the sub-committee for the following reasons:

1. That the method provided for the test at only one temperature, 25 degrees Centigrade, designated as the "normal penetration." It was considered by the committee that the customary hot and cold penetrations should have also been provided for.

2. That no actual data were submitted relative to the so-called ice-water method of cooling the samples. This practice was considered by some of the committee members as deserving investigation.

While the members of the sub-committee on penetration felt that both features were amply covered in last year's work, and they have nevertheless given another year's efforts to the subject, with a view of meeting the wishes of the committee. Two meetings, with practically full attendance, have accordingly been held, and a large amount of correspondence has been conducted.

At the meeting of September 13, 1915, it was decided to conduct some collaborative tests using the proposed method in comparison with an "ice-water" procedure for cooling the specimens. Bermudez and high-paraffin Mexican asphalts, at both paving-cement and road-binder consistencies, were selected as types of materials for this purpose.

In line with our study of the needle question, it was also decided to compare with the usual needle a special form devised in the laboratory of the United States Office of Public Roads and Rural Engineering by Messrs. Reeve and Pritchard.

Eight sets of samples and six special-type thermometers, supplied for the work by the C. J. Tagliabue Manufacturing Company, were distributed among eight laboratories and accompanying these were the regular Robert's needles furnished by Mr. Smith and the special needles furnished by Mr. Reeve, The following letter of instruction was also sent to the laboratories:

"Within a few days, you will receive four samples of asphalt on which are to be made the collaborative penetration tests as agreed upon at our meeting in New York City on September 13.

"Two of these samples will be Bermudez products sent out by Mr. J. S. Miller, and the other two, Mexican products furnished by the writer. Both sets will consist of a binder, or soft, sample, and a harder material, approximately that of asphalt paving consistency.

"On these samples, kindly determine, as promptly as possible after receipt by you, their penetration by the following methods:

"1. Ice-water Method. Melt the samples at as low a temperature as possible, and after stirring to insure uniformity, pour into a three-ounce Gill style, flat-bottom, deep-pattern, seamless, tin ointment box (same as Proposed Method).

"Place in ice-water maintained at 41 degrees Fahrenheit until 'set,' and then immerse completely in the ice-water and allow to remain for a period of one-half hour.

"At the end of the immersion period, transfer to a constant temperature water bath maintained at 25 degrees Centigrade and allowed to remain for three-fourths of an hour, and take penetration by the use of the usual type needle. Temperature bath and details of manipulation, except as above modified, shall conform to those laid down under 'Recommended Procedure.'

"Make at least three separate tests on each sample and enter the results in the proper spaces of the enclosed blank report.

"2. Proposed Method, Usual Needle. Pour another set of all four samples, preferably at the same time as those for the ice-water method are prepared, and proceed strictly according to our 'Proposed Method' as described in the authorized reprint which is enclosed.

"Make at least three separate tests on each sample and enter the results in the proper spaces of the form which is enclosed, retaining samples for the following method:

"3. Proposed Method, Special Needle. On each of the samples used in the above Proposed Method, make at least three more penetration tests, using this time the special type of needle sent out recently by Mr. Reeve.

"Enter results in the proper spaces of the enclosed report form.

"Upon the conclusion of your tests, date and sign the report and mail it to the chairman, who will, in turn, send copies of the tabulated data to all the members, so that we shall be prepared to discuss the same at our next meeting.

"I am also sending for use in connection with these experiments one thermometer from a set of six which were loaned especially for the purpose by the C. J. Tagliabue Manufacturing Company. All of the instruments indicated 77 degrees Fahrenheit when tested in the writer's laboratory in the customary bath maintained at that temperature and will, therefore, assure uniformity in this feature of the collaborative tests. They may be purchased by the individual members at a cost of $1.67 each, or they can be returned to the chairman at the close of the work.

"Kindly acknowledge receipt of the samples and this circular letter. Yours very truly,

"Leroy M. Law, *Chairman.*"

The results obtained from these tests were tabulated at the last meeting of the sub-committee, held on March 22, 1916.

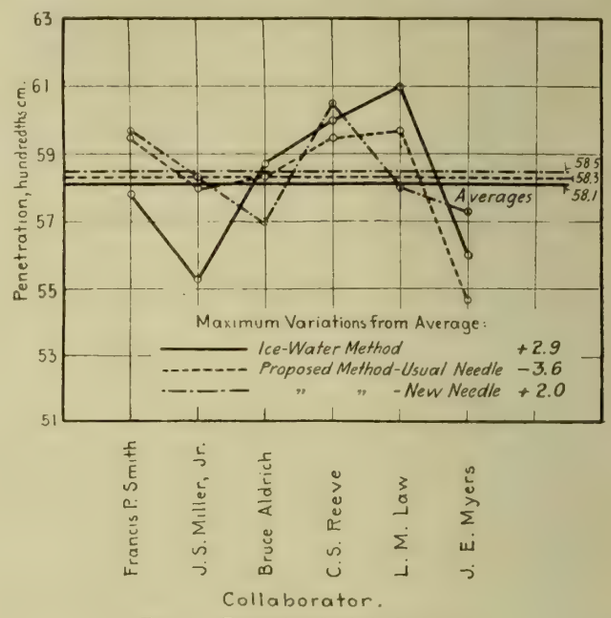



Fig. 1.—Bermudez Asphalt Cement.

One of the thermometers was reported to be in error to the extent of five degrees Fahrenheit—an unfortunate feature

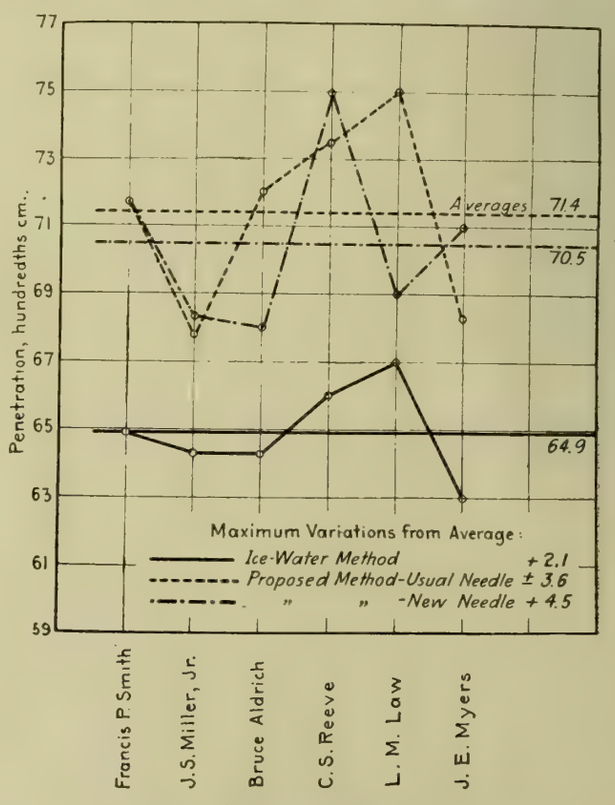



Fig. 2.—Mexican Asphalt Cement.

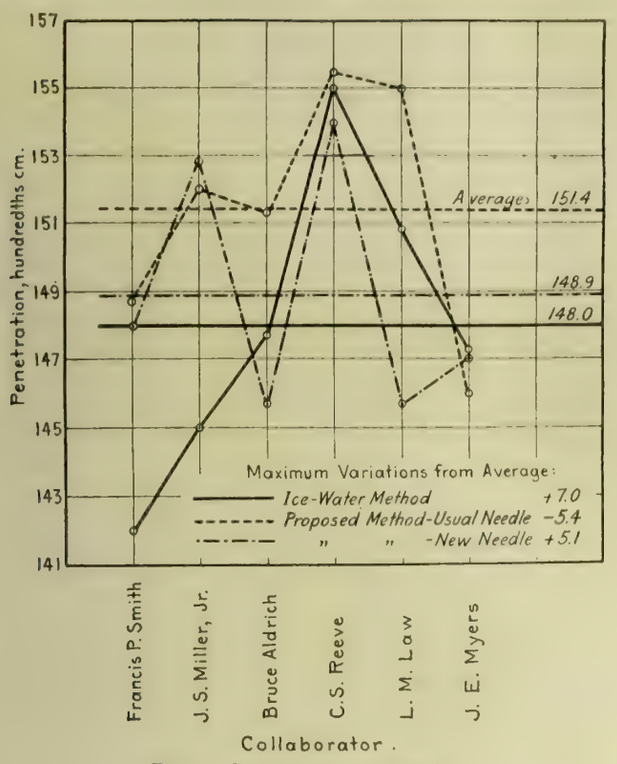



FIG. 3.—Bermudez Asphalt Binder.

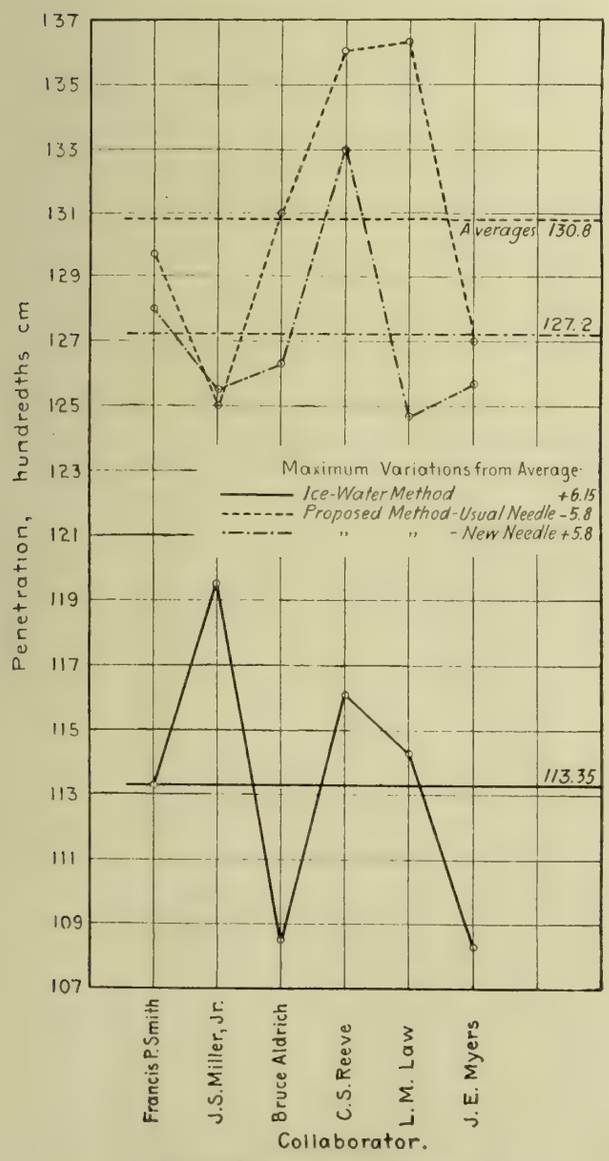



FIG. 4.—Mexican Asphalt Binder.

which, thus far, the sub-committee has been unable to check up; therefore the reports of two laboratories using this same instrument were withdrawn. This left six collaborative reports on the four materials sent out, and through the courtesy of Mr. Miller of this sub-committee, copies of the charts prepared at our last meeting are shown in Figures 1, 2, 3, and 4.

These charts need little explanation and are corroborative of the experience of all the members of the sub-committee on work extending over a number of years. They show in most instances low results by the ice-water method, especially with the Mexican asphalt binder (Figure No. 4), and there is also in general a greater variation from the average by this method.

TABLE I.—COLLABORATIVE TESTS ON PENETRATION OF BITUMINOUS MATERIALS.

BRUCE ALDRICH.

| Kind of Asphalt | Ice-Water Method, Usual Needle. | | Proposed Method | |
|---|---|---|---|---|
| | | | Usual Needle. | Special Needle. |
| Bermudez Asphalt Cement. | 58, 59, 59 | 58 7 | 59, 58, 58 | 58 7 — 57, 57, 57 — 57 |
| Mexican Asphalt Cement. | 65, 64, 64 | 64 3 | 72, 72, 72 | 72 — 68, 68, 68 — 68 |
| Bermudez Asphalt Binder | 148, 148, 147 | 147 7 | 152, 152, 150 | 151 3 — 147, 145, 145 — 145 7 |
| Mexican Asphalt Binder | 108, 109, 109 | 108 7 | 132, 130, 131 | 131 — 126, 127, 126 — 126 3 |

J. S. MILLER, JR.

| | | | | |
|---|---|---|---|---|
| Bermudez Asphalt Cement | 55, 55, 56, 55 | 55 2 | 57, 57, 59, 59 | 58 — 59, 58, 58, 58 — 58 2 |
| Mexican Asphalt Cement | 64, 64, 65, 64 | 64 2 | 68, 68, 67, 68 | 67 7 — 69, 67, 68, 69 — 68 2 |
| Bermudez Asphalt Binder | 144, 146, 145, 145 | 145 | 152, 152, 153, 151 | 152 — 153, 151, 153, 154 — 152 7 |
| Mexican Asphalt Binder | 120, 121, 118, 119 | 119 5 | 125, 126, 125, 124 | 125 — 126, 126, 125, 125 — 125 5 |

FRANCIS P. SMITH

| | | | | |
|---|---|---|---|---|
| Bermudez Asphalt Cement | 58, 58, 57, 58 | 57 7 | 61, 59, 59, 59 | 59 5 — 60, 59, 60 — 59 7 |
| Mexican Asphalt Cement | 65, 64 5, 65, 65 | 64 9 | 71, 72, 72 | 71 7 — 71, 73, 71 — 71 7 |
| Bermudez Asphalt Binder | 141, 141, 143, 143 | 142 | 149, 148, 149 | 148 7 — 148, 148 — 148 |
| Mexican Asphalt Binder | 113, 112, 115, 112 | 113 2 | 131, 128, 130 | 129 7 — 127, 130, 127 — 128 |

J. E. MYERS.

| Kind of Asphalt. | Ice-Water Method, Usual Needle | | Proposed Method | |
|---|---|---|---|---|
| | | | Usual Needle | Special Needle |
| Bermudez Asphalt Cement | 56, 55, 57 | 56 | 55, 55, 54 | 54 7 — 57, 57, 58 — 57 5 |
| Mexican Asphalt Cement | 61, 63, 65 | 63 | 68, 68, 69 | 68 3 — 71, 71, 71 — 71 |
| Bermudez Asphalt Binder | 149, 146, 147 | 147 3 | 148, 146, 144 | 146 — 147, 146, 145 — 147 |
| Mexican Asphalt Binder | 110, 107, 108 | 108 3 | 126, 125, 128 | 127 — 126, 123, 128 — 125 7 |

When it is considered that the six collaborators had carefully rehearsed the details in advance, it is most likely that such variations will be greater in general commercial work.

The results with the special needle are considered sufficiently satisfactory to warrant recommendation as the official type. Its definite diameter and taper facilitate the establishment of a standard and the production of duplicates, both of these features deserving our attention during the coming year.

As a result of the year's work, the Sub-Committee on Penetration recommends essentially the same procedure of last year, necessary and desirable modifications covering the new needle and the penetrations at other than the normal temperature, of course, being appropriately incorporated.

In regard to the latter feature, the sub-committee deems it best to adhere to previous practice of the society, namely,

temperatures of zero, Centigrade (32 degrees Fahrenheit) and 46.1 degrees Centigrade (115 degrees Fahrenheit.)

The sub-committee feels that it has given full consideration to its assignment during the past two years and presents the proposed Standard Test for Penetration of Bituminous Materials appended to the report of Committee D-4, as the best it can offer as an arbitration procedure. This test, in its essentials, has gained considerable publicity through the publication of our progress report last year. It is already in use by most refineries and many leading testing laboratories, and no adverse criticisms have been received by the chairman. It is, therefore, recommended that it be referred to letter ballot of the society for adoption as standard.

Since the compilation of the above report, another series of tests has been made by the operator reporting a defective thermometer, this time using an instrument employed by one of the other collaborators. The results obtained fully support

LEROY M. LAW.

| | | | |
|---|---|---|---|
| Bermudez Asphalt Cement | 61, 61, 61, 61 — 61 | 60, 60, 59, 60 — 59.7 | 58, 58, 58 — 58 |
| Mexican Asphalt Cement | 67, 67, 67 — 67 | 78, 76, 76 — 76 7 | 69, 69, 69 — 69 |
| Bermudez Asphalt Binder | 150, 153, 150, 150 — 150.7 | 156, 154, 156, 154 — 155 | 145, 146, 146 — 145 7 |
| Mexican Asphalt Binder | 113, 114, 116, 114 — 114 2 | 136, 136, 137 — 136.3 | 125, 124, 125 — 124 7 |

C. S. REEVE.

| | | | |
|---|---|---|---|
| Bermudez Asphalt Cement | 60, 60 5, 60 5 — 60 | 59, 60, 59 5 — 59 5 | 60 5, 60, 61 — 60 5 |
| Mexican Asphalt Cement | 66, 65, 66 5 — 66 | 73 5, 73 5, 73 5 — 73 5 | 75 5, 75, 74 5 — 75 |
| Bermudez Asphalt Binder | 156, 153 5, 155 — 155 | 156 5, 153 5, 156 5 — 155 5 | 156, 152 5, 154, 154 5 — 154 |
| Mexican Asphalt Binder | 115, 116, 116 — 116 | 136 5, 136, 136 5 — 136 | 132, 133, 134 5 — 133 |

HERBERT SPENCER.

| Kind of Asphalt. | Ice-Water Method, Usual Needle. | Proposed Method. Usual Needle. | Proposed Method. Special Needle. |
|---|---|---|---|
| Bermudez Asphalt Cement | .. .. .. | 53, 55, 55 — 54.3 | .. .. |
| Mexican Asphalt Cement | .. .. .. | 68, 69, 69 — 68.7 | . . |
| Bermudez Asphalt Binder | .. .. .. | 142, 143, 141 — 141.7 | . . |
| Mexican Asphalt Binder | .. .. .. | 123, 123, 124 — 123.3 | .. .. |

the conclusions of the sub-committee as outlined in the report, and will be found among the detail reports (Herbert Spencer) of the various collaborators. Copies of the detailed reports of the various collaborators are shown in the accompanying tables.

* * *

## Annual Convention Southern Appalachian Good Roads Association

### Lexington, Kentucky, Sept. 5-8, 1916

LEXINGTON, Kentucky, has been chosen as the convention city for the eighth annual meeting of the Southern Appalachian Good Roads Association, and the dates are September 5 to 8, inclusive.

"To Encourage the Building and Maintenance of Good Roads in the Southern Appalachian States" is the motto of this association, which includes nine States: Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama, Tennessee, and Kentucky. It is receiving the co-operation of the highway departments of these States and with that of the board of commerce of Lexington expects to make this one of the best conventions ever held in that section.

As shown by the following tentative program subjects of much interest and vital importance to the States comprising this association will be discussed and a large attendance is urged of all road officials throughout this section.

TENTATIVE PROGRAM.

TUESDAY, SEPTEMBER 5, 1916.

*Morning Session, 10:30 O'clock.*

Convention called to order, Joseph Hyde Pratt, President, presiding.

Opening prayer.

Address of welcome.

For Lexington—Mayor.

For Lexington Board of Commerce.

For the State of Kentucky—Governor A. O. Stanley.

Responses.

For the Association—Joseph Hyde Pratt, President.

Reception to delegates.

*Afternoon Session.*

Devoted to business session of Kentucky State Good Roads Association.

WEDNESDAY, SEPTEMBER 6, 1916.

*Morning Session, 10:30 O'clock.*

Reports of officers and appointment of committees.

Report of the secretary.

Report of the treasurer.

Membership committee.

Resolutions committee.

Publicity committee.

Committee on nominations and next meeting place.

FEDERAL AID.

The Recently Enacted Federal Aid Bill—Hon. L. W. Page, Director, United States Office of Public Roads and Rural Engineering.

A Discussion of the Federal Aid Bill from the Standpoint of the States—Mr. George P. Coleman, Chairman, Executive Committee of the American Association of State Highway Officials and State Highway Commissioner of Virginia; Mr. W. S. Fallis, State Highway Engineer of North Carolina; Mr. J. J. Murray, Secretary, Department of Highways of Tennessee; Mr. W. S. Kellar, State Highway Engineer of Alabama; Mr. Robert C. Terrell, ex-Commissioner of Public Roads of Kentucky.

GENERAL DISCUSSION.

*Afternoon Session.*

Construction of Roads in the National Forest Reserves Through Federal Aid—Mr. Francis Keifer, Assistant District Forester of United States Forest Service.

DISCUSSION.

National Highways and Good Roads Everywhere—Mr. Z. D. Dunlap, Assistant Director of the National Highways Association.

Report of Committee on Construction Progress—Mr. Henry Roberts, of Bristol, Virginia, Chairman.

Progress of Road Work by States:

Maryland—Mr. Henry G. Shirley, State Road Engineer.

Virginia—Mr. C. B. Scott, Secretary State Highway Commission.

West Virginia—Mr. A. D. Williams, Chief Road Engineer.

North Carolina—Mr. W. S. Fallis, State Highway Engineer.

South Carolina—Mr. E. J. Watson, Commissioner of Agriculture, Commerce, and Industries.

Tennessee—Mr. J. J. Murray, Secretary Department of State Highways.

Georgia—Professor C. M. Strahan, Head of the Road Department of the University of Georgia.

Alabama—Mr. W. S. Kellar, State Road Engineer.

Kentucky—Mr. Rodman Wiley, Commissioner of Public Roads.

THURSDAY, SEPTEMBER 7, 1916.

*Morning Session, 10:00 O'clock.*

ROAD MAINTENANCE.

Maintenance of Roads Constructed Through Federal Aid—Mr. Robert James, in Charge of the Division of Maintenance, United States Office of Public Roads and Rural Engineering.

The Patrol System—Mr. Henry G. Shirley, President of the American Association of State Highway Officials and State Road Engineer of Maryland.

The Maintenance of our Dirt and Sand-Clay Roads—Professor C. M. Strahan, of the University of Georgia.

GENERAL DISCUSSION.

Condition of our Mountain Highways after the Recent Floods and their Repair.

Reports of State Highway Engineers present.

Relation of the State Highway Department to County and District Work—Mr. A. D. Williams, State Road Engineer of West Virginia.

*Afternoon Session, 2:30 O'clock.*

Use of States' Prisoners on Public Roads—Joseph Hyde Pratt, State Geologist of North Carolina.

DISCUSSION.

Use of the Automobile Tax in Road Maintenance.

Progress Reports from Representatives of Counties and Good Roads Association.

Progress Reports from Representatives of Special Highways:

The Wilderness Road through Kentucky.
Knoxville-Atlanta.
Asheville-Murphy-Atlanta.
Central Highway of North Carolina.
Knoxville-Cumberland Gap-Cincinnati.
Hickory Nut Gap (Charlotte-Asheville).
Bristol-Charlotte.
Memphis-Bristol-Washington.
Boone Way.
Bristol-Bluefield-Pittsburgh.
National Highway.
Jackson Highway.
Dixie Highway.

Reports from County Engineers.

Reports of Committees and Election of Officers.

FRIDAY, SEPTEMBER 8, 1916.

Visits to Several Stock Farms and Points of Interest.

FRIDAY AFTERNOON.

Matinee trots at the Kentucky Trotting Horse Breeders' Association track.

Adjournment.

* * *

## Road Improvement in Alaska

WE have heard a lot about road development in every part of the United States with the exception of Alaska, a territory more than twice as large as Texas, and by far the most valuable possession owned by this country. Alaska was purchased by the United States in 1867 from Russia for $7,200,000, then thought to be a fabulous price for what was thought by many to be a useless possession. But in the last fifteen years, Alaska has yielded an output of $549,644,333 in gold, silver, copper, miscellaneous minerals, fisheries, furs, and other merchandise, although, by the last census, it had a population of only 64,356.

For about twenty years after the purchase of Alaska, the United States Government absolutely neglected this wonderful country. Then only slight interest was taken for a few years. Seventeen years ago, however, the Government started activities on a small scale, but early discovered that until means of transportation were provided, there would not be much progress. At that time, therefore, Colonel W. P. Richardson, of the United States Army was sent there, and since that time he has been charged with all-important work of opening trails and building wagon roads. Colonel Richardson is chairman of the Alaska Road Commission and is under the immediate control of the War Department. Since going to Alaska, he has devoted all his energies to the work in hand. This is a work too that might well have discouraged one who was less courageous than he.

Before the work could be undertaken with anything like the chance of success, a great deal of preliminary examination, surveying, and reconnaissance of possible routes were required, and the actual work of construction was only started about ten years ago. The country is difficult, and even almost impassable in many districts, the climate is forbidding; the season in which field work is possible is short; the appropriations are small; the cost of labor and of supplies is heavy, and the public interest in the work is not great. But this pathfinder, Colonel Richardson, has his monument in the ways that have already been opened through this wilderness.

Since the work of road construction was actually started in 1906, the Alaska Road Commission has constructed and maintained 901 miles of wagon roads, 557 miles of winter sled roads, and 2,216 miles of trails, making a total of 3,674 miles of highways of all kinds that have been constructed in ten years.

The average cost of building the wagon roads has been about $3,000 per mile. The average cost of building the winter sled roads has been about $325 per mile, and of the trails about $100 per mile. These figures include the cost of the original surveys, all maintenance and all overhead charges since the work was commenced. The expense of maintaining the summer wagon roads has been relatively high because of the soil and climatic conditions in Alaska. The Alaska Road Commission does not class any of the roads constructed in that country as automobile roads, and has not, in fact, encouraged the use of automobiles on them. The truth of the matter is, however, that there are now in service on the different roads that have been completed, upwards of one hundred trucks and passenger cars.

The summer traffic on the Fairbanks-Valdez wagon road has been steadily increasing and proper strengthening of the weak spots would add immensely to the value for heavier traffic on this and other similarly constructed roads, and would be, therefore, a direct benefit to the entire community. To demonstrate that the motor car fever has reached Alaska, it is reported by one of the district superintendents that no sooner had the Juneau-Sheep Creek road been opened than it was subjected to the heavy traffic of passenger-carrying vehicles, ten automobile stages regularly using this road under all kinds of weather conditions, and carrying daily from five to six hundred passengers.

Passenger automobiles are, of course, desirable, but the roads of Alaska have been designed and constructed for what the people of that section regard as another and more important and practical service, and the official reports show that the roads that have already been constructed are abundantly meeting this requirement. In 1912, for example, the cost of transporting freight and supplies over the Government built and Government maintained roads of Alaska was $1,243,735, while before these roads were built, the cost of transporting the same amount of freight and supplies would have been $3,385,412. The saving thereby affected, it will be seen, amounts to $2,141,677, or just about the total amount that has been expended by the United States Government in the construction of the road and trail system of the territory. This was about sixteen per cent. of the total value of only the mineral output of Alaska in 1912. During the summer of 1912, there was transported over one short road in Nome District, 15,000 tons of freight at the saving of five dollars per ton to the shipper, the quoted rate having been just this much lower than the rate per ton that was quoted prior to the construction of the road. This road has, to date, paid for itself nearly eight times in the six years that it has been built.

Road construction, maintenance, and repair will be continued by the Government in Alaska. New roads will be constructed where most needed just as rapidly as the funds available and the appropriation made will permit, but this will not be done to the detriment of the roads that have already been built, as these latter will be maintained, repaired, and kept in first class condition before money is used for construction. This is an object lesson that far-away Alaska can teach a great many States in this country.

With the completion of the Fairbanks-Seward Railroad, now under construction in Alaska, and for which the Government appropriated the enormous sum of $35,000,000 to the exclusion of practically all Federal Aid for road construction in the United States, there will be even greater demand for the construction of new roads in Alaska to serve as laterals and feeders for the new railroad.

# The Concrete Roads of Wayne County, Michigan

By George D. Steele

IN May we presented an article describing the macadam road system of Franklin County, Ohio. We herewith present a similar article covering the concrete road system of Wayne County, Michigan, that is now famous all over the country for its concrete roads. In an early issue, we will present another article describing the brick road system of Cuyahoga County, Ohio. This third article will be followed by articles describing the system of bituminous macadam and bituminous surface treated roads of Philadelphia County, Pennsylvania, and the system of bitulithic roads that has been constructed in the past three years in Multnomah County, Oregon. These articles are not written from the reports that may be given by those directly interested in the various types of roadway surfaces, but in every case the writer has personally visited the counties in question and has ridden over the entire system, paying careful attention to the topography of the country, the drainage and soil problems, the condition of the roadway surface itself, carefully noting both the good points and the defects of each type of road, the traffic which the various roads are called upon to carry, and other features which so vitally affect the life of country roads.

The history of the working out of the road system of Wayne County is of more than ordinary interest, and sets forth an example which could be followed by any similar county or other given unit almost any place in the country. While it may be known to some, as a great deal has been written in the past five years regarding what has been accomplished by this progressive county, it is not known to the great majority, and a synopsis of the events leading up to and through the construction of this system is given herewith. It might be well to say that Wayne County is rich, and in it is located Detroit, one of the richest and most progressive cities in the country, as well as one of the most beautiful. Detroit is to-day the center of the automobile manufacturing industry, approximately sixty-eight per cent. of the cars produced in the United States being manufactured there. Naturally, with the excellent wages that are paid, a great many cars are owned in the city of Detroit, so that the motor vehicle traffic on the roads is unusually heavy.



EDWARD N. HINES
Chairman Wayne County Commissioners

When the County Road Commission was created in Wayne County in 1906, a definite systematic plan involving the improvement of certain logical routes was outlined, covering a period of years. How this has been worked out can best be told in the words of Edward N. Hines, Chairman of the Board of County Road Commissioners of Wayne County, with whom the writer spent considerable time a few weeks ago.

"We do not take over a road as a county road until we are ready to proceed with its actual construction. At the October session of the Board of Supervisors we make our recommendations as to the roads we desire to take over as county roads, together with the amount of tax we desire levied which cannot legally exceed fifty cents on a thousand dollars of the equalized valuation of the county for the preceding year. The cities and villages of the county contribute their proportion according to their assessed valuation, although no money can legally be spent in any city. Money can be spent in the villages, but only after the village authorities have relinquished their jurisdiction over the road to be improved, and have turned it over to our Board. The Board of Supervisors accept, amend, reject, or alter our recommendations both in the matter of roads to be improved and of the tax to be levied.

"After action by the Board of Supervisors determining upon the roads to be improved, a record is put into our minutes by an aye and nay vote, setting forth our determination to take over the road as a county road; the road is then given a name, which is usually the one by which is it commonly known; that portion of our minutes showing our determination to adopt the road is published for three successive weeks in some newspaper circulating in Wayne County, and notice is served upon the officials of the township in which the road is located, setting forth the above facts. When this action has been properly taken, the jurisdiction of the road passes into the hands of the Board of County Commissioners, and involves the authority to improve, regulate, and maintain it.



JOHN S. HAGGERTY
Wayne County Commissioner

"A survey of the road is then made, plans and profiles are prepared, and these, together with the specifications and application for State reward, are filed with the State Highway Department. Following the provisions of the county road law bids are asked for by advertisement for the construction of the road (a purely perfunctory proceeding, as we have not contracted nor have any proposals been received for the construction of any road for several years past). When the bids are received, we have the option of accepting the lowest one and awarding the contract for the work to that bidder, or of rejecting all the bids and doing the work ourselves under the day labor plan.



WM. F. BUTLER
Wayne County Commissioner

"As soon as weather conditions will permit in the spring, and after the road has been staked out, we prepare and shape the subgrade, doing the major portion of such work with scarifiers and graders, the hauling power for which is furnished by steam tractors or rollers. Careful attention is given the grade to eliminate soft spongy places, and a ten ton roller is used to roll it hard. To produce a good concrete road, thorough drainage is necessary in addition to a good subgrade. Both proper drainage and grade are difficult to cope with in Wayne County, as the county for most part is flat and situated in a valley not easily drained. The subsoil is largely of heavy, sticky clay, with some loose, deep sand.

"Our great problem has been in getting the materials on the subgrade, and various plans are followed on the different roads, due to varying conditions. On long hauls we use an industrial railway to transport all materials from the point of receipt to the point of construction. This outfit consists of a seven ton, thirty horse-power locomotive, sixty 1,000-pound double side V-shaped steel dump cars each of one and one-half yard capacity, and eight sixteen-foot flat cars, all of two foot gauge. The track is furnished in built-up units, fifteen feet in length, consisting of steel rails fastened to steel ties. A turnout may be laid wherever needed by replacing a section of track by a switch or curve, as this is also furnished in fifteen foot lengths, and of such radius that locomotive and cars will pass through readily. Two men can handle a section of track weighing 275 pounds. We have two outfits of this character.

"Of course it is not necessary to turn the engine around, as it pushes as well as pulls the load. The average train consists of thirty loaded cars, although as many as forty-two cars have been hauled.

"Materials for the work begin to arrive before actual concreting is in progress. These are immediately unloaded by a clamshell bucket and thrown into stock piles. After concreting has been in progress, the materials are unloaded directly from the railroad cars to the steel dump cars and transported to place. The unloading crew consists of four laborers, an engineer, and a team and teamster. The team hauls seven loaded cars to the siding where trains of thirty cars are made up. Whenever shipments are delayed, the stock piles are resorted to for materials. Work is started at the end farthest away from the railroad switch. Five miles per hour is the average set speed, including time for coaling and watering. The actual running speed enroute is from eight to ten miles per hour.

"There is no danger of dumped materials falling back upon the track, as the center of the pile is about three feet from the edge of the nearest rail. Two men are able to tip a loaded car body. Materials are readily measured in the cars and distributed along the road at such intervals as to best meet the requirements of the mixer. The aggregates are loaded into the dump cars, the cement in any available cars, and the expansion plates, asphalt filler and other necessities on the flat cars. Coal for the mixer is likewise brought to the site over the railway. As concreting progresses, the haul becomes shorter and the track is taken up. These rail sections are transported to the loading point on the return trips of the train.

"The tracks for our industrial railway can be laid on any surface over which transportation of any kind is at all possible. Rainy weather and muddy roads do not impair the efficiency of rail haulage, nor is the load too heavy for the ordinary highway bridge. A factor of much importance is that very little hauling space is required. When necessary, the track can be laid on the berm of the road, so that it is possible to haul material either in the same direction as the concreting is proceeding or else in the opposite direction. The railway, too, is practically independent of labor conditions, as one engineer and two brakemen make up the entire crew required. Although the unit rail sections provide an easy method of crossing highways and steam and electric lines, and the clearing of these when necessary by removing the rail sections, it is not always possible to obtain permission to make such crossings.

"Where the use of the industrial railway is not feasible, we use a combination of team and engine hauling. Teams work economically on short distances, but weather conditions are at times a handicap, and at certain seasons of the year the demand is so great for them generally that they are difficult to secure. Our traction outfits are also handicapped by bad roads, rainy weather, and the limited speed which they are capable of attaining. Road rollers furnish the motive power largely for hauling wagons, each of which holds seven tons of material. Over earth roads, one wagon is usually all that can be drawn. When, however, a concrete road is available for hauling, six wagons containing forty-two tons of material are made up into a train and hauled by one ten ton road roller. Our hauling operations involve the use of two industrial outfits, eight traction outfits, and from one hundred to one hundred and fifty teams.

"One man on the grade has full charge of the dumping of the materials, and he is furnished with the following table in order that the material may be properly placed to minimize rehandling. This is important, as considerable time and money can be lost or wasted through insufficient materials being placed, or by placing too large quantities of material along the road, necessitating additional handling after the mixer has moved on.

MATERIALS TO BE PLACED PER 100 FOOT STATION

| Width of Metal in Feet | Barrels of Cement | Cubic Yards of Sand | Cubic Yards of Gravel |
|---|---|---|---|
| 12 | 45 | 12 | 26 |
| 15 | 56 | 16 | 33 |
| 16 | 60 | 17 | 36 |
| 18 | 68 | 20 | 39 |

The above quantites, based on wagon loads when team hauling was the method of distribution, basing forty-five sacks of cement to the load, one and one-third cubic yards of gravel to the load and one and one-third cubic yards to the wagon load, would be equivalent to the following number of loads:

| Width of Metal in Feet | Cement | Gravel | Sand |
|---|---|---|---|
| 12 | 4 | 20 | 10 |
| 15 | 5 | 25 | 12 |
| 16 | 6 | 27 | 13 |
| 18 | 6 | 29 | 15 |

"The foreman in charge of the distribution of materials is also given a series of tables of quantities showing the amounts required on different widths of roads, so as to avoid surplusage at any given point. These quantities are what is required for one mile.

"Stockpiles are also established in the fall at various unloading points, so that breakdowns, car shortages, intermittent or irregular deliveries will not interfere with the work after getting under way in the spring.

"During the past year we have encountered long hauls very generally. On the Huron River Drive, the farthest point of haulage was seven and one-third miles. On the Seven Mile Road the shortest point of haulage was about four and one-half miles.

"The transportation of water, of which we use large quantities in mixing and curing the concrete, and supplying the mechanical equipment, such as concrete mixers, traction engines, road rollers, etc., has often been a serious problem. We have solved this by laying two-inch pipe along the road from the nearest source of supply, and pumping the water along the routes either by gasoline engines or electric motors. We have pumped water a distance of ten miles, which was the nearest source of supply. We have also piped water from the water works system of Detroit, Plymouth, and Grossee Points.

"Our standard width for secondary roads is sixteen feet with a minimum width over all of twenty-four feet. The concrete is six inches thick at the sides and eight inches thick in the center, and built on a flat subgrade. Six-inch channels twelve feet in length are used instead of wooden forms along the sides. As these forms are subsequently used to support the templet and the bridge from which the finishers work, great care must be exercised to get them true and rigid. Expansion joints consisting of two thicknesses of asphalted felt (about one-fourth of an inch) inserted between two Baker Armour Plates, are placed in the road twenty-five feet apart.

"We use a concrete mixer which travels under its own power, from which a twenty foot boom projects, and which swings over a 180 degree arc. The dumping is carried out on this boom under power and eliminates much hand labor. One batch consists of three sacks of Portland cement, four and one-half cubic feet of sand and nine cubic feet of gravel. The specification that the batch shall receive sixteen complete revolutions and that it shall remain in the mixer drum for fifty-five seconds is resulting in producing an excellent quality of concrete. Batches are discharged at intervals of about two minutes. On a sixteen foot road the crew of thirty-two men is able to lay approximately 450 linear feet of concrete during a ten hour day. As high as 525 linear feet have been laid, however, when conditions were at their best.

"Before any concrete is placed, in order to prevent absorption of the water from the mixed concrete by the subgrade, the latter is thoroughly wet down. The mix is fairly wet, and of such consistency that the men working in it sink in four and five inches. Clean material is an absolute requisite to securing good concrete. Our pebbles are washed and screened so as to

be free from loam, clay, and any other foreign substance. They range from one-fourth to one and one-half inches, and are so graded as to reduce the voids to a minimum. Our sand is bank sand, washed and screened, free from loam, clay, etc., and ranges in size from one-fourth inch down to dust, with the coarser particles predominating. Wayne County has no stone hard enough for our purposes, and all stone and sand used are shipped from outside points.

"When the mixer is close to the stock piles, congestion is avoided by having six men load the barrows and six men wheel the materials to the mixer. Wheelers and shovelers alternate in their work for each successive block of concrete, a scheme that has proved efficient because the variety of work tends to prevent its becoming monotonous. When the stock piles are a relatively great distance from the mixer, each of the twelve material men loads and wheels his own barrow, so that a continuous stream of material is always enroute.

"The concrete is brought to grade and shape by the use of a templet. This templet, or strike board, is made of two-inch plank, preferably in a single piece, the curvature of the under edge being made to exactly conform to the finished surface of the concrete road, which is crowned approximately one-fourth of an inch to the foot. On each side of each end is an iron handle for drawing the templet back and forth. The curved edge is shod with one-inch angle irons bent to the curvature of the templet, thus giving it a metal wearing surface. The length of the templet exceeds the width of the road metal by one foot. A twelve inch plank is suitable for widths of road metal up to and including eighteen feet. If the road is wider than this, a built-up form of templet is necessary, which is trussed to prevent a sag or flattening of the crown. This templet or strike-board is then sawed back and forth on the side rails, and moved slightly forward at each stroke, giving the concrete its initial shape. After this no workman is permitted to disturb the concrete in any way, or to step or throw anything upon it. This rule is imperative, as a violation of it means a road with waves and depressions by causing the neat cement and the finer particles to rise to the top. We aim to have the stone take the wear, as it is the hardest part of the concrete.

"The final finishing up of the road is done by two men whom we term floaters, who work from a bridge which rests on the side-rails, and which has no actual contact with the concrete. A wooden trowel of home manufacture is used for this purpose. The use of a trowel of this nature prevents the road from becoming slippery.

"One crew used a finishing machine throughout the entire construction season last year, for shaping and finishing the road with very satisfactory results as far as the quality of the work produced, but up to date the cost of finishing with this machine has been higher than by finishing the old way by hand. The better results secured in eliminating depressions and irregularities, however, justifies this small increase in cost, and we will undoubtedly add this advice this year to our standard mechanical equipment.

"When the concrete will stand of its own weight, the side rails are removed, and it has been our custom in the past to make a small bevel by cutting off the edges of the concrete with a shovel. This prevents a sharp division line between the concrete and the shoulders. Each day's work is finished up to an expansion joint, and no more than twenty minutes is permitted to elapse between batches during the day. The day following the laying of the concrete, it is covered with a couple of inches of sand or loose soil such as is available, and is sprinkled during the day for ten continuous days. This prevents the road from drying out and is an important factor in properly curing the concrete so that it will attain its maximum hardness and strength. Plenty of water is vitally essential in producing good concrete.

"Roads are not opened for traffic until from four to six weeks have elapsed after the last batch of concrete is laid; the length of time depends upon the season of the year as concrete sets up much more slowly in cold weather than when it is hot and dry.

"Shoulders of crushed stone or gravel, whichever is the more available, are built three to seven inches thick and three to four feet wide on each side of the concrete; on many roads, additional width of earth shoulders is built. This work is not started until after the road is at least four weeks old.

"During the past year, 1915, most of our work has been carried on well away from towns where suitable quarters could not be obtained for the men, so we provide sleeping and eating quarters in tents along the road. The men obtain food from the nearest town and cook their own meals, while the water supply for the roads usually serves as well for the men. The mixer crew's quarters are kept at sites a convenient walking distance from the work, and the men unloading the transporting materials live in tents pitched close to the railroad siding.

"Three concreting crews were maintained in the field during the past summer, and to each town of these is attached a grading crew, a shouldering and ditching crew, an unloading outfit, and a culvert crew. An additional bridge and culvert crew was also kept busy building bridges and culverts over roads previously constructed and improved. All work is specialized and machinery is used wherever possible, since man and horse labor are scarce and expensive in the country districts during the road-building season. Many little economics and labor-saving devices have been worked out which increase both the quantity and the quality of our work, and our whole aim is to produce a durable and dustless road at cost for the people of Wayne County."

The road construction that has been under way in Wayne County for some years was made possible by the authorization and issue of a road bond issue of $2,000,000, of which $300,000 has already been retired, and an additional $100,000 will be retired this fall. The roads which were built with this money are still in first class condition, and there is every indication that they will more than outlive the bond issue.

The county commissioners of Wayne County have, up to the beginning of this year, constructed a total of 164.5 miles of roads, of which 130 miles are concrete. There have also been built twenty miles of gravel road, 2.5 miles of brick and twelve miles of penetration macadam. The schedule for this year calls for the construction of twenty-five miles of additional road, all of which will be concrete. There are 1,370 miles of roads of all types in the county, improved and unimproved. This does not include roads through villages and cities. The aim and intention of the commissioners is to continue the construction of concrete roads until 350 miles have been built, which mileage will form a systematic network over the county which will accommodate ninety per cent. of all the traffic in the county, and which will be so planned that no resident or farmer in the county will be more than three miles from a concrete road, over which he can travel to connecting concrete roads to the markets he desires to reach.

This year a tax of one-half mill on the equalized assessed valuation of the county will produce $315,000 for road work, to which will be added $161,000 carried over from last year, making a total of $476,000 available for construction and maintenance in 1916. The entire proceeds of the $2,000,000 bond issue authorized by the people of Wayne County in 1912 has now been expended, so that it is necessary, to continue the work, to revert back to the county road tax referred to above. This tax is limited to fifty cents on a thousand dollars of the equalized assessed valuation of the county for the preceding year.

As an indication of what improved roads mean to Wayne County, it is only necessary to point out the increased assessed valuation of the townships outside of the city of Detroit since 1906, in which year the county road system was adopted. On October 1, of that year, the assessed valuation of townships, cities, and villages outside of Detroit was $62,707,003, and eight years later it had jumped to $114,548,122, an increase of $51,841,119. On the other hand, the assessed valuation of Detroit was $355,363,747 in 1906, and $524,956,500 in 1914. Expressed in terms of percentage, the valuation of Detroit, during a period of phenomenal growth in the past eight years, has increased .477 per cent., while the valuation of the townships in the same period has increased .826 per cent. There is no question but that the benefits derived through better transportation facilities have been largely responsible for this increase. Instead of the road system of the county being a tax on the community, it has furnished new value to tax. Detroit formerly paid eighty-three per cent. of the tax of Wayne County, but now pays eighty per cent., owing to the increased county valuation.

Regarding certain detrimental reports made against Wayne County concrete roads, Commissioner Hines has the following to say:

"With the exception of finishing up the small stretch of brick roadway on Gratiot Road, which was let by contract, and 643 feet of gravel construction on the Ford Republic Road, all of our work is of standard concrete construction and has been done under our own supervision and jurisdiction by our own forces. We have made no changes in our concrete specifications, as we feel that the manner in which our concrete roads have stood the test of time and use during the past seven years, and the small amount spent annually on their upkeep is ample justification for our adherence to the specifications we have evolved and the methods we have followed in their building. We have never taken up and replaced a twenty-five foot section since we have been building and developing this type of road and its freedom from ruts and holes has permitted us to devote our energies and moneys to new work instead of resurfacing and repair work, which forms so large a part of the activities of other communities where a less durable type of road has been built at the outset."

The Board of County Road Commissioners of Wayne County owns a large amount of road construction and maintenance equipment. This is made necessary by the fact that the commission does practically all road work by force account, few contracts every being awarded. This equipment is housed at a central point at Wayne, where extensive yards, buildings, sheds, and shops are maintained. At the end of each construction season, all machinery and epuipment is returned to this point, where ample space has been provided for the mechanics to completely overhaul the equipment during the idle winter months. Any practical repair can be made there, and a stock of the most necessary repair parts is carried. The small force of mechanics and laborers employed there during the winter months repairs and paints all equipment so that it is always in first class condition when the construction season opens up in the spring. Nothing is overlooked that will ten to stay depreciation and decay of equipment. The stimated value of the buildings and the equipment housed in them at Wayne is $160,000. This equipment includes the following:

Nineteen miles of "Koppel" industrial railway track.

One hundred eighty one and one-half yard "Koppel" side dump cars.

Two "Koppel" dinkey hauling locomotives.

Two Lima Locomotive Works dinkey hauling locomotives for use on grades.

Seven Port Huron Engine & Crusher Company road rollers and traction engines.

One Longecker road roller and traction engine.

Twenty miles of two and three-inch pipe for water supply lines.

One one-yard Austin Cube concrete mixer (Paver).

Three one-half yard Austin Cube concrete mixers (Pavers).

Two small Austin Cube mixers for culvert construction.

Three Brown Hoisting Machine Company hoists.

Seventy-five Port Huron Engine & Crusher Company automatic spreading bottom dump wagons.

Six Port Huron Engine & Chrusher Company sprinkling wagons.

Four scarifiers.

Eight gasoline driven contractor's pumping outfits for water supply, etc.

Six J. D. Adams Company "Road King" road graders.

Six Ford cars for the paymaster and district superintendents.

One Studebaker car for inspection work.

One Packard six-ton truck with dump body and hydraulic hoist for spreading stone on the shoulders and for maintaining shoulders.

A large supply of miscellaneous equipment and small tools, tar kettles, etc.

## The Maintenance of Wayne County Roads

### By Edward N. Hines

In highway construction, two factors—cost and efficiency—must always be foremost in considering the type of construction to be selected. The taxpayer is generally most interested in cost, but often fails to appreciate the fact that the first cost is relatively a secondary consideration. Low first cost might, and generally does, mean that ultimate cost will make construction of low initial price the most expensive in the end. "How much will it cost?" should include careful estimates as to what maintenance will be necessary to keep the road in condition as nearly comparable to new as is possible, and to render its purchasers—the taxpayers—the greatest value for their money. For this reason the first cost is not the sole measure of efficiency.

To think that a road once built, regardless of the material used, is built for all time is erroneous. No type of construction, however nearly it may approach perfection, is free from the human element, a factor which plays an important part towards efficiency. Recognizing that durability and low cost of maintenance largely determine the success of any type of road, our preference in Wayne County, based on our past seven years' experience, continue to be for concrete construction. We believe in constant and systematic maintenance of all roads under our jurisdiction. As in past years, our gravel and macadam mileage continue to absorb the bulk of our maintenance moneys and energies. We have repaired and oiled all gravel roads and in addition thereto, have dragged them systematically in both the spring and the fall. The macadam mileage on the Eureka, Fort, and Mt. Elliott Roads has again been resurfaced during the past year, at heavy expense, and will eventually be replaced with concrete. The macadam mileage on the River Road was oiled last spring, pending its replacement with concrete, which work is now in progress. The macadam mileage on Gratiot Road was replaced last year with concrete. All ditches and culverts are cleaned out, both in the spring and in the fall, weeds, and brush along the roads are burned several times annually after they have been cut away from the roadside, all guard rails and bridges are painted wherever necessary, and the shoulders are given whatever attention they may require.

Last year, with about forty-five miles of additional road to look after, part of which was a year and part two years older, we spent on maintenance from October 1, 1914, to September 30, 1915, a smaller sum by $5,178.04 than we spent in the corresponding period the year previous. This was brought about by the replacement of a number of miles of bituminous macadam with the more durable and less expensively maintained concrete. In our case, the wisdom of building of concrete, in our judgment, stands out conspicuously when maintenance cost involved in keeping all other types of roads under our jurisdiction in usable condition is compared with the actual cost of maintaining our concrete. Yet, even the best concrete road will require some maintenance, consisting principally of cleaning out and refilling expansion joints, the repair of pockets which occasionally appear on the surface as a result of some foreign material such as clay getting into the concrete, some fragment of inferior pebble or stone, or defects in workmanship. Usually no maintenance is required on our concrete roads the first year of their life, but if we find that any is necessary, we do it promptly and thoroughly.

A crew consisting of seven men and a team, provided with a tar kettle, is used for our maintenance work. Last year the foreman was paid $5 per day, the team and driver $5 per day, two of the laborers $2.50 per day, and the other two $2.25 per day each. The tools carried by this crew consist of several wire bristle brooms, a wheelbarrow, a couple of shovels, sprinkling cans, and a tar bucket. Two men are used to sweep all cracks or spalled joints clean with the wire brooms, after which the man with the tar can fills the cracks with tar which is heated to about 225 degrees Fahrenheit, allowing it to stand for a few moments to prevent it from bubbling. It is then covered with a clean, coarse, dry sand, spread from a shovel. Pit holes are similarly treated. An excess of tar and sand is used and traffic is allowed to iron it out. We use a grade of tar known under the trade name of Tarvia with a melting point of about eighty-five degrees Farhenheit. Tarvia comes in several grades, designated by letters, but we use a special mixture graded between Tarvia A and Tarvia X.

Where an imperfection exists that does not extend through the road, but which is over an inch in depth, we clean and dry it out carefully, painting it with hot tar, after which it is filled with stone of a suitable size graded to fill the voids as nearly

as possible. This is then tamped down or rolled into place. Hot tar is then poured over the patch, the quantity being gauged so that the tar will be taken up by the remaining voids without any large excess being left on the surface, and coarse dry sand is then spread with a shovel over this surface. Holes of a lesser depth and any joints from which the filler has wholly or partly disappeared come in for the class of treatment already described for cracks and joints.

Our maintenance crew will cover from one to three and one-half miles of road in a day, and one trip annually over each road is usually all that is required. Last year our maintenance crew had gone over the entire mileage of concrete roads by the middle of August. On three of our concrete roads we have about two miles (total) where the entire surface of the concrete is covered with a bituminous carpet. This mileage has also been taken care of as during the past. The same grade of Tarvia is used as for other maintenance purposes. But instead of sand, washed and screened pebbles are used. It is necessary to resurface about one-third of this mileage annually, in addition to touching up spots here and there throughout the entire season. The method followed has been to sweep the spots treated with wire brooms after which the tar is poured. The pebbles are then spread over the tar from barrows or a wagon, and traffic then embeds the pebbles in the tar, forming a wearing surface. The surfaces of these roads become wavy under traffic and are not as desirable as an all-concrete wearing surface either from the standpoint of the comfort of the user of the road or from the standpoint of ultimate cost.

We have also repaired a few holes that were two or more inches deep by cleaning them out, painting them with a cement grout, and filling the cavity with a concrete mixture of the same proportions as that used in the construction of the original road; the concrete being mixed to the same consistency, as nearly as possible, to that of the original construction. The repaired portion is cured by keeping it wet for at least seven days and protected from traffic until thoroughly hardened.

A comparison of our maintenance costs with those of other localities where roads are maintained in good usable condition and where $1,000 per mile and upward is being spent each year, will prove instructive. Our concrete roads possess the special feature of presenting a surface that wears but slightly and uniformly; a surface that does not give away in any one spot, and withstands traffic over its entire surface. This is made possible by the careful selection of materials, careful methods of proportioning and mixing, and care in finishing and curing, resulting in a concrete having a uniform texture, which is a big factor in eliminating maintenance costs. We have over 125 miles of concrete road in Wayne County, some of it in its eighth year of service, and all of it in good condition. We have never taken up and replaced a twenty-five foot section since we have been building and developing this type of road, which, we think, speaks volumes for our low annual maintenance costs.

On our brick mileage we have treated the cracks which have developed and the bricks that were not too badly chipped in the same manner as we have handled the cracks in our concrete roads. It has made a very satisfactory repair and gives promise of adding materially to the life of our brick roads. Broken brick have been replaced from time to time and the roads have been given an occasional sweeping and cleaning.

We have also found it advisable to use a road scraper to keep the snow leveled down during the winter months, more especially on the roads on which there are street car tracks. The scraper was drawn behind a motor truck and made travel much safer, besides distributing it over a wider area of roadway. In fact, every effort is made to keep our roads in proper condition for travel throughout the entire year with a minimum of expenses.

The total cost of maintenance work on the roads under our jurisdiction during the period from October 1, 1914 to September 30, 1915, was $25,355.64.

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The county road commissioners have asked for $30,000 for maintenance this year out of the $315,000 tax levy. This amount will not, however, according to Mr. Hines, be needed, but is asked for to provide for any emergency that may happen to come up. The average cost of maintaining the macadam sections of roads in Wayne County is from $1,000 to $2,500 per mile. The average cost of maintaining the gravel roads, including oiling them once during the year, is $500 per mile. The cost of maintaining the brick roads, including sweeping and cleaning at least once a year, is a little more than $100 per mile. The cost of maintaining the concrete road surface only is a trifle under $30 per mile. This does not include spreading the crushed stone along the shoulders, which is done once or twice a year, or oftener if necessary, nor does it include in the case of the concrete roads the trimming of weeds, cleaning of ditches and culverts, etc.

Last year the commissioners expended about $5,000 on the maintenance of the entire width of the concrete roads in the county, $10,000 on the maintenance of the gravel roads, and $5,000 on the maintenance of the macadam roads. The balance was expended for culvert repairs, clearing of snow in the winter, and miscellaneous charges.

The county's forces average about one hundred working days on the roads to the year, and the average cost of concrete road construction, including everything that goes to make the finished road, is from $15,500 to $16,000 per mile for the standard width. All labor is in charge of the superintendent in charge of construction, who has full power to employ and dismiss his men. The only exception to this rule is the timekeeper on each road, who is directly under the county commissioners' office.

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## Rigid Paving Urged for Motor-Used Streets

FOR some weeks past, the *New York Commercial* has been publishing a series of editorials and articles on paving for New York City. Owing to the enormous amount of new subway construction on Manhattan Island, mile after mile of the streets have been torn up and a wooden flooring replaces the old street surfaces over the open cuts from building line to building line. This naturally means that as soon as the construction work on the subways is completed, new pavements will have to be laid, and there is considerable agitation among the residents along these streets, property owners, etc., for various types of paving. Several of these articles published in the *Commercial* were called to the attention of Mr. A. N. Johnson, Consulting Highway Engineer, of the Portland Cement Association, Chicago, and he had the following comment to make regarding them.

"I have read with more than ordinary interest the editorials and interviews that have recently appeared in the *New York Commercial* in regard to traffic ways to meet the needs of modern traffic. As is brought out in these editorials, it is evident that if the traffic facilities of a given street are to be maintained at a maximum, it is absolutely necessary that fast and slow moving traffic shall be segregated, and where, as is pointed out by W. H. Perry, Secretary of the Good Roads Committee of the National Automobile Chamber of Commerce, that to-day there are streets in New York on which the motor traffic is over ninety per cent. of all the traffic and where this traffic has increased in the past five years eighty-four per cent. in the number of vehicles and one hundred and forty-two per cent. in tonnage, the recommendation that there should be set aside for motor traffic certain main arteries is a rational solution of the problem.

"In selecting the type of pavements for motor traffic there is one principle that may well be kept in mind, which is that this class of traffic demands a rigid road surface. We can no longer successfully maintain a proper road surface with a resilient type of pavement. The resiliency must be in the vehicle and not in the pavement. Of all types of rigid pavement surface, there is none that can be built and maintained at the same low cost and offer as good traffic surface as a well constructed concrete pavement. Such a pavement is not only smooth, but at the same time offers the greatest resistence to skidding. No pavement which becomes slippery for motor traffic when covered with a film of moisture can give that security which is necessary if a motor traffic way is to permit motor vehicles to operate at the rate of speed which would facilitate traffic movement. There would be little use in setting aside any main artery to motor traffic if it is to be paved with any material which prevents safe operation at increased speed under all weather conditions, as the very purpose of the motor traffic way would be thus defeated.

"There is also another large field for the use of concrete pavements, and that is in the parkways, which to-day carry

practically nothing but motor traffic. Most of these parkways are now old gravel or macadam roads which the city is attempting to maintain by various surface treatments of a bituminous character. The results are not successful in spite of the comparatively large expenditures that are made, as any one readily observes by a trip over the parkways in the different parks. Not only would the parkways be far more useful than at present if paved with concrete, but a great saving in the end by the taxpayers through greatly lessened cost of maintenance."

* * *

## A Digest of the Various Laws

### That have been passed in 1916 by the State of New York relating to Motor Trucks and which relate to the Motor Truck Club of America and Truck Owners

THE use of the motor truck during the past few years has grown so rapidly that special legislation is being passed by many States regarding their use, etc., and New York State, with a larger number and heavier trucks than any other State, seems to be taking the initiative. At any rate, other States are watching very closely all legislation regarding motor trucks that is passed by New York, the Empire State, and a digest of the laws that have been passed this year will prove of more than passing interest.

The following laws have been passed by the 1916 Legislature, and all became effective upon the approval of them by the governor.

#### NEW INSURANCE REGULATIONS

An Act known as Bill Number 97, introduced in the Senate, which became effective as Chapter Number 13 of the Laws of 1916, to amend the insurance law in relation to the creation of mutual companies to make insurances upon or pertaining to automobiles against any or all of the hazards of fire, explosion, transportation, collision, and certain other hazards.

This law provides, in brief, that twenty-five or more persons may incorporate. No insurance shall be written until at least one thousand persons owning not less than 1,500 automobiles have agreed to take insurance. Annual premiums shall amount to not less than thirty thousand dollars ($30,000) at the rates charged by the company. No insurance shall be written until the facts specified in this section have been certified under oath to the Superintendent of Insurance by at least three of the persons signing the original certificate, and the Superintendent of Insurance has issued a certificate of authority to transact such business. The Superintendent of Insurance shall be satisfied that the applications for membership are bona fide; that applicants will agree to take policies within a period of three months from the date of the issuance to the corporation by the Superintendent of Insurance of a certificate of authority to transact business. If at any time the membership falls below one thousand, or the number of cars below fifteen hundred, or the premium cost less than thirty thousand dollars ($30,000), no further policies shall be written by the corporation until the amounts increase to those specified. The Superintendent of Insurance will give reasonable time in which to bring up the number of insured, etc. If not then complied with, it is then his duty to take up proceedings for the liquidation of the corporation.

There must be thirteen directors. All excepting four directors must be members of the corporation. The corporation must maintain the same reserve for the protection of policyholders as stock insurance corporations. The Superintendent of Insurance may suspend or cancel the certificate issued by him at any time that the assets of such corporation are insufficient to insure and secure the payment of these policies and other obligations. The expenses of management should not exceed in any one calendar year thirty per cent. of the premium income in such year, but the expenses of management shall not be held to include the expenses incurred in investigation, adjustment, and settlement of claims.

The members shall be liable for not less than an amount equal to twice the amount, and in addition to, the cash premium written in the policy.

The terms of policies must be approved by the Superintendent of Insurance, and reports must be made to him, just as is the case with other companies.

Foreign mutual automobile fire insurance companies may, after January 1, 1919, do insurance business in New York State provided such foreign mutual company has the qualifications of domestic corporations, organized under this article, provided, however, that in no event shall authority be given to any such foreign mutual corporation organized to do other kinds of insurance than those specified in this article.

At meetings of the corporation, each member shall have one vote for each automobile owned, except that no member shall have more than three votes.

An Act known as Senator Bill Number 98, which became effective as Chapter 11 of the Laws of 1915, was passed to amend the Insurance Laws in relation to the creation of mutual companies to make insurances upon or pertaining to automobiles against loss or damage resulting from accident to, or injury suffered by, any person, and for which the person insured is liable, and also certain other insurances upon or pertaining to automobiles.

This law is very similar in purport to the above mentioned law, excepting that it provides that the amount of the premium income shall be fifty thousand dollars ($50,000) instead of thirty thousand dollars ($30,000).

#### NEW BASIS FOR MOTOR TRUCK TAX

The Act known as Senate Bill Number 1312, introduced by Senator Hewitt, which became effective as Chapter 598 of the Laws of 1916, to amend the Highway Law in relation to the registration fees for certain motor vehicles.

This law gives the Commissioner of Highways, the Superintendent of Public Works, and the State Engineer and Surveyor the power and duty to adopt and file in the office of the Secretary of State a set of schedules of registration fees to be paid upon the registration or re-registration of motor vehicles in accordance with the provisions of the article on motor vehicles, commonly known as motor trucks, and provides that in fixing such fees they shall classify such motor vehicles upon the basis of the time and the extent of their use on the public highways, and the relative wear and tear on the public highways by reason of their use thereon. The fees provided by this schedule shall take effect February 1, 1917, and shall, as to the motor vehicles included in such schedule, supersede the provisions of Subdivision Number 6 of this section as to the amount of registration fees therefor.

Sub-division Number 6 reads as follows:

"The following fees shall be paid to the Secretary of State upon the registration or re-registration of a motor vehicle in accordance with the provisions of this article: five dollars upon the registration of a motor vehicle having the rating of twenty-five (25) horsepower or less; ten dollars upon the registration of a motor vehicle having a rating of more than twenty-five horsepower and less than thirty-five horsepower, and fifteen dollars upon the registration of a motor vehicle having a rating of fifty horsepower or more; provided that if a motor vehicle is originally registered after August 1 in any year, the registry fee for that year shall be one-half of the fee herein provided for; and further provided that for motor vehicles which are used or to be used solely for commercial purposes, the fee for such registration shall be five dollars. The provisions hereof with respect to the payment of registration fees shall not apply to motor vehicles owned or controlled by the State, a city, or county, or any of the departments thereof, but in other respects shall be applicable.

#### SENATOR HEWITT'S STUDIES TO COST $5,000

Senate Bill Number 1,428, introduced by Senator Hewitt, which became effective as Chapter 638 of the Laws of 1916, provides for an appropriation of five thousand dollars ($5,000) to be used in preparing a schedule of registration fees to be paid by motor trucks.

#### THAT HE WHO RUNS MAY READ

An Act known as Assembly Bill Number 1,423, introduced by Mr. Machold, which became effective as Chapter 579 of the Laws of 1916 provides that the Secretary of State shall have issued a brief summary of all local ordinances relating to the speed of motor vehicles, at regular intervals. This is certain to be a pamphlet of unusual value.

#### DISPOSITION OF FEES

The Act known as Senate Bill Number 600, introduced by Senator Brown, which became effective as Chapter 577 of the Laws of 1916, provides that the Secretary of State shall pay

to the State Treasurer fifty per cent. of the registration fees collected under the Highway Law, and shall pay to the treasurer of each county the other fifty per cent. of the registration fees collected from residents of such county. In the city of New York, such payments shall be made through the Chamberlain of such city on account of all counties included therein and all moneys received by the Chamberlain pursuant to this article shall be paid into the treasury of the city to the credit of the general fund.

While the users of motor trucks in New York State have had no cause for complaint heretofore in so far as the registration fees are concerned, it can readily be seen that the new schedule of fees to be determined by the Commission formed under Senator Hewitt's Bill Number 1,312 is liable to be unfair unless the Commission is well advised and has the viewpoint of the user in mind as well as that of the State revenue collector.

The Motor Truck Club of America, New York City, is taking a deep interest in this matter, and will make every effort to have the Commission impartially consider the matter from all angles before the new registration fees are finally adopted, as it is the common belief that the increase of fees proposed, based upon the time and extent of use and the wear and tear on the highways, will have an important bearing on the future use of trucks in the State. It is also the purpose of the Club to particularly point out to the Commission that the belief that large rubber-tired trucks do more damage to the roads than the smaller vehicles is erroneous. Several States have recently passed laws which have discriminated against large trucks, apaparently neglecting the fact that the pressure per square inch of tire surface, one of the factors in road damage, is the same, due to the load-bearing properties of rubber.

* * *

## Highway Bridge Construction in Michigan

UNDER the existing highway laws in Michigan, the duties which devolve upon the State Highway Department, by virtue of the State's participation in bridge construction. include the furnishing of advice, designs, and supervision for the construction of bridges and culverts on State reward roads, and the design and construction of bridges over thirty feet in span on trunk line roads. Michigan first began to improve her highways under the State aid plan in 1905 but it was not until 1913 that bridge construction became truly an integral part of the work of the Highway Department. During that year, the legislature passed an act which provides for a comprehensive system of trunk line highways. The activities and powers of the department were greatly increased thereby, notably with respect to trunk line bridge construction. The bridge department was accordingly enlarged and organized along purely scientific and business lines.

A provision of the highway laws permits the county or township road commissioners to apply to the State Highway Department for plans and specifications for any bridge which is to be repaired or rebuilt at a cost of more than $500 and for supervision of the construction of the same. One of the first steps in the interests of greater efficiency and economy which was instituted by the reorganized bridge department was to prepare standard plans for short span culverts and bridges. As an example of what may be saved by the use of such plans, it might be cited that during one season the State contracted for all rolled I-beams for all bridges to be built and was enabled thereby to secure the material at less than one-half what the average township or county has paid for it in the manner in which it is usually bought.

Corresponding economy has also resulted on many larger structures handled by the department for the various townships and counties. In particular, large savings have been effected by taking separate bids on the foundation and superstructure. In one instance, $2,000 was saved in this way and a better bridge secured than the township was able to obtain under the old methods.

In the standard plans for reinforced concrete abutments, an unusual combination of principles of abutment construction has been embodied in the design which has resulted in considerable saving in numerous instances. The economical design of abutments, especially those which must retain a great depth of embankment, presents a difficult problem to the engineer. In highway work, also, it is of the utmost importance that the plans should be made as clear as possible in order that the inexperienced contractor can build the structure with the least amount of oversight. With this end in view, all battered surfaces have been omitted and a perspective drawing is shown. Tales of dimensions and of reinforcing bars required make it possible to show in clear and concise form on one sheet all details for various abutments ranging in depth from ten to twenty feet.

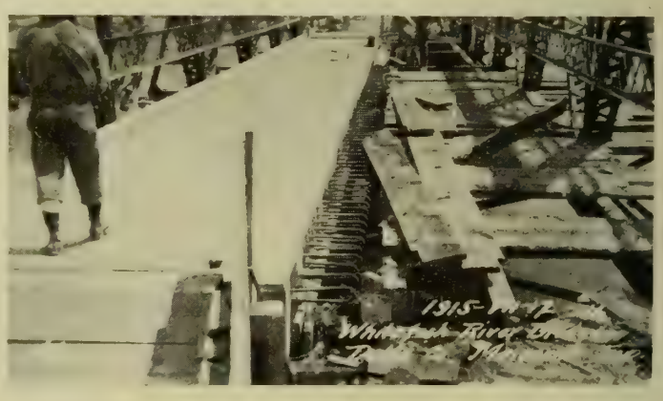
For abutments of a greater height than ten feet, it has been found best to turn back a portion of the wing walls parallel with the roadway. This construction limits the width of the structure to the right-of-way and the part turned back acts as



Standard Short Span Reinforced Concrete Bridge

a counterfort to support the wings. The counterfort is usually covered by the embankment. The economy of this design over the cantilever abutment is due to the fact that stability is maintained by the general shape of the footing rather than by the width of the footing at any one section. The saving with this type of design increases rapidly with the height. At a height of twenty feet above the top of the footing there is a saving of approximately thirty per cent.; at a height of twenty-five feet, a saving of fifty per cent. over the cost of a gravity abutment.

More noticeable, however, have been the results accomplished by the department in the construction of bridges over



Laying One-Half of Floor and Maintaining Traffic at the Same Time

thirty feet in span under the provisions of the trunk line highway act. The aim has been to design and construct bridges which will carry the greatest loads which may reasonably be expected to come upon them and will serve the community for a long period of years. As an example one way in the future is being provided for, it might be noted that while the statutory limit of the capacity of bridges is fifteen tons, all trunk line bridges are designed to carry an eighteen-ton roller. The Pine River bridge in Macinac County shown in the accompanying illustration is typical of the class of structures erected by the department. It will be noticed that inside knee braces have been

used on the trusses. This is one of a number of important constructional features which have been incorporated into the newer bridges.

As the travel is quite heavy on most of the trunk line roads, construction of the bridges must be carried on with the minimum interruption of traffic. In order to maintain traffic while erecting the new bridge, the following procedure has been adopted in many instances: The old bridge is jacked up and the new one constructed outside of the old structure, which is also of service in the erection. When the framing has been completed, the old bridge is removed and planks placed on one-half of the new bridge while the concrete floor on the other half is poured. After ten days, the traffic is allowed to go over the new floor and the remainder is completed. The accompany photograph illustrates this detail.



Pine River Bridge in Macinac County, Michigan

The State has a schedule of bridge work on trunk line roads this season for the construction and rebuilding of thirty-three bridges, ranging in cost from $2,500 to $30,000, the total estimated expenditure being $225,000. Prominent among these is a large reinforced concrete arch bridge which is now under construction just southwest of Grand Rapids. This bridge has a clear span of sixty feet and has a sixty-six foot roadway. It is being built in conjunction with Kent County and the Grand Rapids, Holland and Chicago Railway, whose tracks occupy the center of the bridge. Also worthy of note is the bridge designed to span the Huron River at French Landing in Wayne County. This bridge is to be a 130 foot deck Pratt truss, which, with the concrete approaches, will make the total length over 400 feet.

The counties may earn bridges on trunk line routes by constructing three miles of road, including the bridge, according to the specifications of the State Highway Department. Already they are willing to build more than enough roads to take the State appropriations, the growth of which has been phenomenal. On the first of July, an appropriation amounting to $550,000 became available for trunk line purposes. This sum will be used for making trunk line surveys, paying rewards, and a large portion for building bridges. Future progress is largely dependent upon the ability of the State to meet its share of the cost.

* * *

## Road Building in West Virginia

Despite the fact that the roads in West Virginia are in the best condition for travel at the present time, agitation for hard surface roads goes merrily on. The movement for permanent highways in this State has come to stay, and unless there is a decided change in the attitude of the people, its magnitude will be increased as time goes on.

At the outset of the movement the farming element of the State was somewhat skeptical as to its genuineness, but a close study of the agitation at the present time, reveals the fact the farmers are in the foreground. Their prejudices and skepticism have been overcome, thanks to the combined efforts of the business and professional men of the various cities of the State, and from now on less opposition will be found among the West Virginians who gain their livelihood from the cultivation of the soil.

The same condition is apparent in West Virginia now, as existed in other States when the good roads movement started. The farmer was the most difficult man to convince and convert, but when once enlightened and enlisted, he proves to be the moving spirit. Up until a short time ago, a good hard surface road in West Virginia has been considered more or less of a luxury, but to-day, it is looked upon as a necessity, and one of the most valuable assets in the community.

West Virginia farmers are cultivating their soil along scientific lines, due to the activity of the Extension Department of the West Virginia Agricultural College, and consequently, they are becoming as much interested in marketing their crops, as they have been in growing them. It is a common sight now, to see farmers driving into the cities with truck loads of fresh vegetables, over improved roads, whereas a few years ago, such a sight was classified as being the "Eighth Wonder of the World."

West Virginia primarily is a mining State, and secondarily an agricultural State, but with the improvement of her roads the latter industry will have reached the proportions of the former, and when this point is attained, the Little Mountain State will be the "Garden Spot of America."

* * *

## Oklahoma

As the fiscal year of the various counties ends on June 30 and the month of July is largely devoted to the making of budgets for the ensuing year by county commissioners and the sharp reducing of such budgets by the Excise Boards. New work projected during the month of July has been very scarce and except for the continuation of existing contracts the county engineers have to a considerable extent marked time since June 30.

Interest in roads and bridges has been particularly marked all over the State as the first general primary since the passage of the present highway law was held on August 2, and nearly every candidate for county commissioner ran on a "good roads" platform. Several candidates for State Senator and State Representative made similar campaigns.

The State Engineer made an inspection of the bridge across Grand River in Saline Township, Mayes County, where the Vincennes Bridge and Iron Company is working on a contract which was awarded in 1914 but execution was delayed by injunction proceedings that were finally decided in the Supreme court. County Engineer Pratt and the commissioners are working with the bridge company and getting a fine job, but are handicapped by "sore spots" holding over from the injunction

Mayes County commissioners are getting most excellent results with their force culvert building. The average cost of such work on some seventy openings, ranging from three to twenty-four feet, and including all material, labor, forms, and supervision, is about eight dollars per cubic yard as shown by paid vouchers. Work on road surfacing is not progressing so well owing to hot, dry weather.

An inspection of road and bridge work in Rogus County shows that the county commissioners as ex-officio township officers were getting most excellent results in the building of roads and culverts, and their excellent locations in bad spots show that they appreciate the value of the services of the county engineer. The heavy fill across the Verdigris River between Claremore and Collinsville is a very creditable piece of work and the supported grade, side hill work from the valley to the summit west of the river on the same road would do for any mountain country.

The State Engineer in company with the county commissioners inspected the work being done by State convicts in Pottawatomie County, and the new location of the Tecumseh-Asher road and reported good work.

Mr. R. E. Brownell, county engineer of McIntosh and Pottawatomie Counties, has resigned and joined the forces of the National Association of Portland Cement Manufacturers, reporting for duty on August 1 to the Dallas office of the association. Mr. Brownell will travel in Oklahoma and Northern Arkansas doing missionary work in the interest of "Concrete for Permanence."

Mr. L. L. Winnans has been assigned to the State of Oklahoma by the office of Public Roads and Rural Engineering for

an indefinite period, and, for the present, will continue the work on the Williams Highway in Pottawatomie County.

Mr. Davis, Junior Highway Engineer, has been assigned by the Department of Agriculture for demonstration work in Pittsburg County and application for his services has been made by the commissioners of McCurtain County.

Mr. Hardy, Junior Highway Engineer, has been assigned to Atoka County and will probably go from there to Bryan County. Bryan, Atoka, and Pittsburgh Counties are all concentrating their forces on the improvement of the Jefferson Highway and are making excellent progress with heavy grading and bridge work but surfacing is being held back by lack of moisture.

The highway department has approved the application of LeFlore County for fifty convicts and ten teams to be used on construction of the road through Winding Stair Mountains. This road follows exactly that part of the old army trail from Fort Smith, Arkansas to Fort Towsen, Oklahoma, located by army engineers in frontier days.

Application of Johnston County for thirty convicts to be used on the Missouri, Oklahoma, and Texas Highway has been approved as has also the application of Kirk Township, McCurtain County for the same number for use on their township road system.

The highway department has approved forms of bridge and road records and township officials' reports.

Mr. George W. Mitchell has been appointed County Engineer of McIntosh County. Mr. L. Alvah Bond has been appointed Engineer of Greer County.

The plans for a hard surface road across Blue Mountain in Damon Township, Latimer County, have been approved and proposals for the construction of same will soon be called for.

The election for $100,000 bridge bonds in Greer County resulted in the decisive defeat of the proposition.

### STATE CONVICT WORK IN ATOKA COUNTY, OKLAHOMA

Thirty State convicts have been employed for about a month on the Jefferson Highway in Atoka County, Oklahoma, and during this time they have cleared approximately one and one-half miles of roadway, fifty feet wide and have removed loose stone and boulders along a distance of eight miles, leaving roadway in a condition that a grader may be used.

The convicts have also built approximately 600 feet of road bed in rocky ground where the grader could not be used.

At this time no figures are available on the cost data of work being done in Atoka County. This work is being performed under the supervision of the county engineer and county commissioners of Atoka County, who are also being assisted by an engineer from the office of Public Roads and Rural Engineering, United States Department of Agriculture. Statistics and cost data may be expected later.

At the time this article is written grading work has just begun, a tractor being used on the grader. Six miles of the Jefferson Highway were graded at a cost of $150 per mile after the roadway had been prepared by the convicts and placed in condition to be graded. It is reported that no other work will be done by contract along this highway but that in future such work will be done directly by the county commissioners using day labor and convict labor.

The road known as the Jefferson Highway reaches from Canada to the Gulf of Mexico. It runs through Atoka County, Oklahoma, for a distance of forty miles. As a great deal of the land in Atoka County is owned by the original Indian allottees and is therefore non-taxable at this time, the officials of this county are handicapped by a lack of funds. Fortunately, however, there is an abundance of road building material along the Jefferson Highway, which will enable them eventually to construct a model highway, both as to road work and culvert work.

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## Good Roads in Ohio

### By Raymond Beck

**Chief of Touring Bureau of the Goodrich Company**

With contracts let and work under construction amounting to nearly twelve million dollars, covering the improvement of over nine hundred miles of road on our inter-county and main market road system, and with hope of fair weather conditions for the balance of the summer, the Ohio State Highway Department is in the thick of the busiest season by far which it has ever experienced. Present indications lend foundation to the belief that the record of last season when, with the worst weather conditions in years, three hundred and fifty-nine miles of State road were built, will be greatly exceeded.

Each succeeding year finds the people of Ohio more eager for good roads, better informed as to the method of securing them, and more thoroughly advised as to the use and preservation of them.

Since taking office in the spring of 1915, State Highway Commissioner Clinton Cowen has been constantly working toward continuity in road improvement. It is his opinion that an expenditure of funds upon a road connecting two definite market centers is a far better return upon the investment than were the same money to be spent in the construction of several roads in different localities, each connecting two lanes of mud.

One acquainted with road conditions in Ohio for the last few years finds the present situation of the Highway Department most gratifying. But a few years ago it was with extreme difficulty that the State Highway Department was able to secure financial co-operation from the county road authorities in even a small number of the counties in the State. A few of the more alert officials were able to secure very substantial sums for expenditure upon the main market roads in their counties by offering to co-operate in the cost of the improvement. Most improvements were made by the State upon inter-county highways and main market roads with no proportion of the cost of construction borne by the county. To-day this condition is almost completely changed. Nearly all of the counties are co-operating with the State in the cost of improving their inter-county highways and where the road officials have failed to take advantage of their opportunities, the people, being now informed as to them, are demanding more progressive action consistent with the procedure followed in the remainder of the counties.

Whereas in the year 1914 four counties were able to secure $500,000 in main market road funds for improvements in these counties, the demand upon the State Highway Department for main market funds at this time is so tremendous that the same amount of money was divided this year among nearly forty counties and the Highway Department was unable to substantially meet the requests made upon it for financial co-operation upon the main market roads of the State.

The counties are now contributing as high as twenty dollars to each dollar contributed by the State in order to secure State financial assistance and engineering supervision on road improvements contemplated in their respective counties.

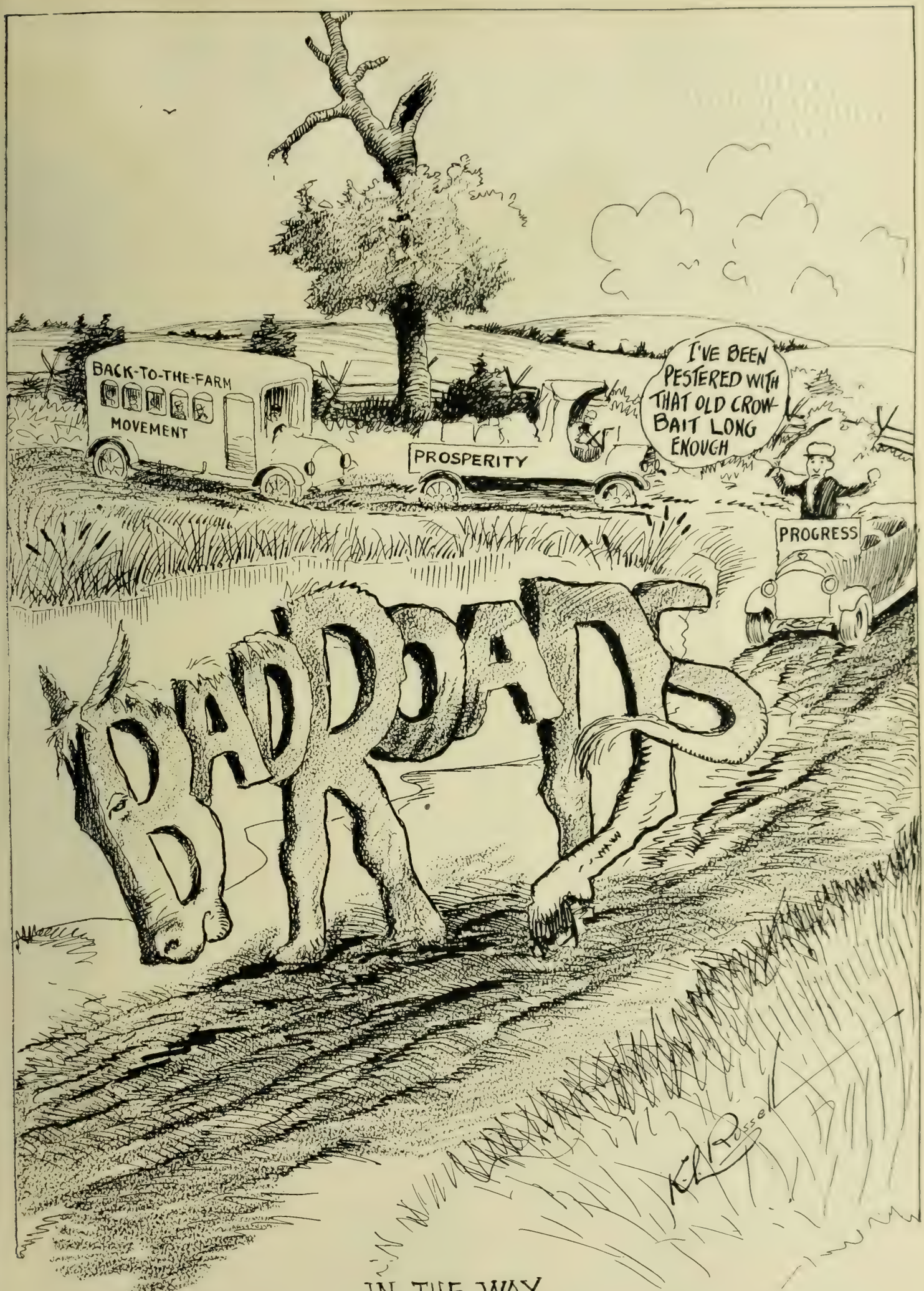
Of the ninety thousand miles of public road in Ohio, the inter-county highway system of approximately ten thousand miles is greater than can be improved for many years with the present levy of but three tenths of a mill, and while it is not the policy of Commissioner Cowen to offer State funds to the county bidding the highest for them, nevertheless each year shows the State's dollar for road improvement constructing more roads and being more intelligently expended.

As an illustration of the statement that road improvement is being given careful, economic consideration by the people, the records of the State Highway Department show that there has been an enormous increase in road repair work; in 1916 Commissioner Cowen anticipates that his Department will repair appreciably more than a thousand miles of road to first-class condition for travel.

The question of systematically maintaining a road when constructed is being given increasingly careful study by the Highway Department and is an evidence that the people of Ohio consider money spent on road improvements in the same manner as any other investment and not to be carelessly wasted.

* * *

The second edition of Harger and Bonney's Highway Engineers' Handbook, containing information and tables ordinarily used in the design and construction of roads warranting an expenditure of $5,000 to $30,000 per mile, is now being distributed by the publishers, the McGraw-Hill Book Company. It is an excellent reference for all engineers, contractors, and road and street officials. The price of the book is $3 and can be had by writing the publishers at 239 West 39th Street, New York City.


BACK-TO-THE-FARM
MOVEMENT
PROSPERITY
I'VE BEEN PESTERED WITH THAT OLD CROW-BAIT LONG ENOUGH
PROGRESS
DADDIES

IN THE WAY

# Philadelphia's Concrete Service Test Road

By William H. Connell, Chief of the Bureau of Highways

*(Continued from August Issue)*

IN the August issue of BETTER ROADS AND STREETS appeared a complete and detailed description of the construction of the Oxford Pike Concrete Service Test Road built under the direction of the writer, as well as specifications covering the materials that were used in this construction work. This road is unquestionable one of the most important roads that has been built, and many engineers consider it the most important for the reason that it will be systematically watched, and that detailed unit costs have been kept from the first day on which work was done. Highway engineers all realize that it is a most difficult matter to secure accurate and authentic cost data, as far too little attention is paid to this most important part of highway construction. The cost data that has been kept in this particular case on this service test road is all reliable and authentic, and while high in comparison with roads more advantageously located for the delivery of materials, housing of men employed on the work etc., it will, making all allowances for unusual conditions, be of inestimable value to highway engineers in planning work in any section of the country, and as a comparison in future years in computing maintenance, will be of even greater value and interest. Accurate cost data on maintenance of the road will be kept, and inspections will be made at close intervals, so that the action of the surface under all conditions can be carefully watched and studied.

The complete cost data of this service test road, by sections, follows:

## SECTION 1.
Station 0+00 to 22+50.

**Composition of Concrete:**
1 part cement; 2 parts sand; 3 parts gravel passing a 1½-inch ring and retained on a ¼-inch screen.

**Expansion Joints:**
From Station 0+30 to 5+40—steel protected joint.
From Station 5+40 to 22+50—bituminous joints.

**Treatment of Surface:**
From Station 0+00 to 10+50—untreated.
From Station 10+50 to 13+50—Tarvia.
From Station 13+50 to 16+50—Ugite.
From Station 16+50 to 19+50—Asphalt Cut-back.
From Station 19+50 to 22+50—Unionite.

### COST PER SQUARE YARD.

| | Per sq. yd. |
|---|---|
| Preparation of subgrade | $0.0878 |
| Concrete pavement | 1.0085 |
| Shoulders | 0.0323 |
| | $1.1286 |
| Bituminous top—Tarvia | $0.1358 |
| Bituminous top—Ugite | 0.1444 |
| Bituminous top—Asphalt Cut-back | 0.1783 |
| Bituminous top—Unionite | 0.2153 |
| Preparation of subgrade, concrete pavement, and bituminous top Tarvia | 1.2321 |
| Preparation of subgrade, concrete pavement, and bituminous top Ugite | 1.2407 |
| Preparation of subgrade, concrete pavement, and bit. top Asphalt Cut-back | 1.1726 |
| Preparation of subgrade, concrete pavement, and bituminous top Unionite | 1.3116 |

### DETAILED COST PER SQUARE YARD.

**Preparation of Subgrade.**

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Scarifying | $ 38.10 | $0.0085 |
| Shaping | 340.25 | 0.0756 |
| Rolling | 16.60 | 0.0037 |
| 4,500 sq. yds. @ $0.0878 | $394.95 | $0.0878 |

**Concrete Pavement.**

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Portland cement, 1,320 bbls. @ $1.60 | $2,112.00 | $0.4693 |
| Jersey gravel, 474.9 tons @ $1.20 | 569.88 | 0.1266 |
| Whole pebbles, 762.3 tons @ $1.20 | 914.76 | 0.2033 |
| Forms, steel and wooden—depreciation | 44.00 | 0.0098 |
| Labor | 84.87 | 0.0189 |
| Joints, bituminous, 59 | 42.67 | 0.0095 |
| steel protected, 17 | 51.85 | 0.0115 |
| Superintendence | 45.45 | 0.0101 |
| Labor, concreting | 368.22 | 0.0818 |
| Covering with dirt | 25.63 | 0.0057 |
| Removing dirt | 14.34 | 0.0032 |
| Pipe line | 17.50 | 0.0039 |
| Sprinkling | 5.58 | 0.0012 |
| Overhead charges for this section alone | 50.75 | 0.0113 |
| Miscellaneous expenses, coal, salaries, etc | 190.60 | 0.0424 |
| 4,500 sq. yds. @ $1.0085 | $4,538.10 | $1.0085 |

**Shoulders.**

Labor: 2,000 sq. yds. @ $0.0323 ..... $64.55
Actual time for laying concrete:
{ 787 cu. yds. / 4500 sq. yds. } 8 days, 4 hours, or an average of { 93.6 cu. yds. / 535.0 sq. yds. } per day.
Highest daily yardage—600 square yards.

**Bituminous Wearing Surface—Tarvia.**
Station 10+50 to 13+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Tarvia B, paint coat, 168 gal. @ $0.09 | $15.12 | $0.0251 |
| Tarvia A, first coat, 168 gal. @ $0.085 | 14.28 | 0.0238 |
| Trap rock chips, 3 tons @ $1.68 | $ 5.04 | $0.0084 |
| Tarvia A, second coat, 210 gal. @ $0.085 | 17.85 | 0.0298 |
| Trap rock chips, 6 tons @ $1.68 | 10.08 | 0.0168 |
| Extra chips, 4.4 tons @ $1.68 | 7.39 | 0.0123 |
| Labor: | | |
| Hauling chips | 3.72 | 0.0062 |
| Sweeping concrete | 2.00 | 0.0034 |
| Spreading chips | 6.00 | 0.0100 |
| 600 sq. yds. @ $0.1358 | $81.48 | $0.1358 |

**Bituminous Wearing Surface—Ugite.**
Station 10+50 to 13+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Ugite A—80 gallons @ $0.09 | $ 7.20 | $0.0120 |
| Trap rock chips—3 tons @ $1.68 | 5.04 | 0.0084 |
| Ugite No. 3—first application, 175 gallons @ $0.10 | 19.50 | 0.0324 |
| Trap rock chips—6 tons @ $1.68 | 10.08 | 0.0168 |
| Ugite No. 3—second application, 210 gallons @ $0.10 | 21.00 | 0.0350 |
| Trap rock chips—6 tons @ $1.68 | 10.08 | 0.0168 |
| Labor: | | |
| Hauling chips | 3.72 | 0.0062 |
| Sweeping concrete | 1.00 | 0.0017 |
| Spreading chips | 7.05 | 0.0118 |
| Rolling | 2.00 | 0.0034 |
| 600 sq. yds. @ $0.1444 | $86.67 | $0.1444 |

**Bituminous Wearing Surface—Asphalt Cut-back.**
Station 16+50 to 19+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Paint coat—78 gallons @ $0.10 | $ 7.80 | $0.0130 |
| Second coat—170 gallons @ $0.10 | 17.00 | 0.0282 |
| Trap rock chips—8 tons @ $1.68 | 13.44 | 0.0224 |
| Labor: | | |
| Hauling chips | 3.72 | 0.0062 |
| Sweeping concrete | 2.00 | 0.0034 |
| Spreading chips | 2.00 | 0.0034 |
| Rolling | 1.00 | 0.0017 |
| 600 sq. yds. @ $0.0783 | 046.96 | $0.0783 |

**Bituminous Wearing Surface—Unionite.**
Station 19+50 to 22+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Paint coat, 78 gallons @ $0.10 | $ 7.80 | $0.0130 |
| Rock asphalt, 3.6 tons @ $15.00 | 54.00 | 0.0900 |
| Trap rock chips, 3.8 tons @ $2.00 | 7.60 | 0.0127 |
| Asphaltic cement, 550 lbs. @ $0.01 | 5.50 | 0.0092 |
| Labor: | | |
| Cleaning concrete | 13.20 | 0.0219 |
| Hauling material | 9.90 | 0.0165 |
| Rolling | 1.80 | 0.0030 |
| Erecting temporary plant | 6.00 | 0.0100 |
| Labor | 23.40 | 0.0390 |
| 600 sq. yds. @ $0.2153 | $129.20 | $0.2153 |

### TABLE OF TEMPERATURES ON DAYS CONCRETE WAS PLACED.

| Date. | Highest during day. | Lowest on night following. | Location of concrete placed each day. |
|---|---|---|---|
| October 12, 1914 | 76° | 57° | Station 0+00 to 0+90 |
| October 13, 1914 | 66° | 54° | Station 0+90 to 3+30 |
| October 14, 1914 | 61° | 56° | Station 3+30 to 6+00 |
| October 19, 1914 | 88° | 55° | Station 6+00 to 10+80 |
| October 20, 1914 | 71° | 57° | Station 10+80 to 13+80 |
| October 21, 1914 | 76° | 60° | Station 13+80 to 14+40 |
| October 22, 1914 | 78° | 48° | Station 14+40 to 18+00 |
| October 23, 1914 | 62° | 50° | Station 18+00 to 21+00 |
| October 24, 1914 | 52° | 48° | Station 21+00 to 22+50 |

From the above table it will be seen that all temperatures were above freezing. Weather conditions were good during the construction of this section.

NOTE—These temperatures are taken from the U. S. Weather Bureau Reports and are from one to three degrees higher than the actual temperatures on Oxford Road, due to its exposed condition.

## SECTION 2.
From Station 22+50 to 45+00.

**Composition of Concrete:**
1 part cement; 2 parts sand; 3 parts trap rock, passing a 1½-inch ring and retained on a ¼-inch screen.

**Subgrade:**
A corduroy road formerly existed from Station 37+20 to 37+60, on account of the "springy" condition of the soil, and a considerable amount of stone was on the subgrade at this point and well rolled.

**Expansion Joints:**
From Station 34+80 to 39+90—steel protected joints.
From Station 22+50 to 34+80 } From Station 39+90 to 43+50 } —bituminous joints.
From Station 43+50 to 45+00—5 steel protected joints at an angle of 30° to the center line.

**Treatment of Surface:**
From Station 22+50 to 25+50—Tarvia.
From Station 25+50 to 28+50—Ugite.
From Station 28+50 to 31+50—Asphalt Cut-back.
From Station 31+50 to 34+50—Unionite.
From Station 34+50 to 45+00—Untreated.

### COST PER SQUARE YARD.

| | Per sq. yd. |
|---|---|
| Preparation of subgrade | $0.1123 |
| Concrete pavement | 1.1408 |
| Shoulders | 0.0237 |
| | $1.2768 |
| Bituminous top—Tarvia | $0.1344 |
| Bituminous top—Ugite | 0.1444 |
| Bituminous top—Asphalt Cut-back | 0.0783 |
| Bituminous top—Unionite | 0.2153 |
| Preparation of subgrade, concrete pavement and bituminous top—Tarvia | 1.3875 |
| Preparation of subgrade, concrete pavement and bituminous top—Ugite | 1.3975 |
| Preparation of subgrade, concrete pavement and bit. top—Asphalt Cut-back | 1.3314 |
| Preparation of subgrade, concrete pavement and bituminous top—Unionite | 1.4684 |

## DETAILED COST PER SQUARE YARD.

### Preparation of Subgrade.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Scarifying | $ 44.80 | $0.0100 |
| Shaping | 437.59 | 0.0972 |
| Rolling | 23.00 | 0.0051 |
| 4,500 sq. yds. @ $0.1123 | $505.39 | $0.1123 |

### Concrete Pavement.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Portland cement, 1,372 bbls. @ $1.60 | $2,195.20 | $0.4878 |
| Jersey gravel, 516.2 tons @ $1.20 | 619.44 | 0.1376 |
| Trap rock { 500.3 tons @ $1.55 / 291.2 tons @ $1.72 } | 775.47 / 500.86 | 0.2836 |
| Forms: steel and wooden, depreciation | 44.00 | 0.0098 |
| labor | 103.19 | 0.0229 |
| Joints: bituminous, 53 | 38.29 | 0.0085 |
| steel, 22 | 41.04 | 0.0098 |
| Superintendence | 63.00 | 0.0140 |
| Labor concreting | 413.70 | 0.0919 |
| Covering with dirt | 20.18 | 0.0045 |
| Removing dirt | 19.48 | 0.0043 |
| Pipe line | 34.58 | 0.0077 |
| Sprinkling | 6.86 | 0.0015 |
| Overhead charges for this section alone | 65.47 | 0.0145 |
| Miscellaneous expenses salaries, coal, etc | 190.60 | 0.0424 |
| 4,500 sq. yds. @ $1.1408 | $5,133.86 | $1.1408 |

### Shoulders.

Labor: 2,000 square yards @ $0.0237 ..... $47.35

Actual time for laying concrete in section No. 2:

{ 787 cu. yds. / 4500 cu. yds. } { 8 days, 3½ hours, or an average of { 94.33 cu. yds. / 539 sq. yds. } per day.

Highest daily yardage—600 square yards.

### Bituminous Wearing Surface—Tarvia.
Station 22+50 to 25+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Tarvia B, paint coat, 168 gallons @ $0.09 | $15.12 | $0.0251 |
| Tarvia A, first coat, 168 gallons @ $0.085 | 14.28 | 0.0238 |
| Trap rock chips, 3 tons @ $1.68 | 5.04 | 0.0084 |
| Tarvia A second coat, 210 gallons @ $0.085 | 17.85 | 0.0298 |
| Trap rock chips, 6 tons @ $1.68 | 10.08 | 0.0168 |
| Extra chips, 3.9 tons @ $1.68 | 6.55 | 0.0109 |
| Labor: | | |
| Hauling chips | 3.72 | 0.0062 |
| Sweeping concrete | 2.00 | 0.0034 |
| Spreading chips | 6.00 | 0.0100 |
| 600 sq. yds. @ $0.1344 | $80.64 | $0.1344 |

### Bituminous Wearing Surface—Ugite.
Station 25+50 to 28+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Ugite A, 80 gallons @ $0.09 | $ 7.20 | $0.0120 |
| Trap rock chips, 3 tons @ $1.68 | 5.04 | 0.0084 |
| Ugite No. 3, first application, 195 gallons @ $0.10 | 19.50 | 0.0324 |
| Trap rock chips, 6 tons @ $1.68 | 10.08 | 0.0168 |
| Ugite No. 3, second application, 210 gallons @ $0.10 | 21.00 | 0.0350 |
| Trap rock chips, 6 tons @ $1.68 | 10.08 | 0.0168 |
| Labor: | | |
| Hauling chips | 3.72 | 0.0062 |
| Cleaning concrete | 4.00 | 0.0012 |
| Spreading chips | 7.05 | 0.0118 |
| Rolling | 2.00 | 0.0034 |
| 600 sq. yds. @ $0.1444 | $86.67 | $0.1444 |

### Bituminous Wearing Surface—Asphalt Cut-back.
Station 28+50 to 31+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Paint coat, 78 gallons @ $0.10 | $ 7.80 | $0.0130 |
| Second coat, 170 gallons @ $0.10 | 17.00 | 0.0282 |
| Trap rock chips, 8 tons @ $1.68 | 13.44 | 0.0224 |
| Labor: | | |
| Hauling chips | 3.72 | 0.0062 |
| Sweeping concrete | 2.00 | 0.0034 |
| Spreading chips | 2.00 | 0.0034 |
| Rolling | 1.00 | 0.0017 |
| 600 sq. yds. @ $0.0783 | $46.96 | $0.0783 |

### Bituminous Wearing Surface—Unionite.
Station 31+50 to 34+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Paint coat, 78 gals. @ $0.10 | $ 7.80 | $0.0130 |
| Rock asphalt, 3.6 tons @ $15.00 | 54.00 | 0.0900 |
| Trap rock chips, 3.8 tons @ $2.00 | 7.60 | 0.0127 |
| Asphaltic cement, 550 lbs. @ $0.01 | 5.50 | 0.0092 |
| Labor: | | |
| Cleaning concrete | 13.20 | 0.0219 |
| Hauling material | 9.90 | 0.0165 |
| Rolling | 1.80 | 0.0030 |
| Erecting temporary plant | 6.00 | 0.0100 |
| Labor | 23.40 | 0.0390 |
| 600 sq. yds. @ $0.2153 | $129.20 | $0.2153 |

## TABLE OF TEMPERATURES ON DAYS CONCRETE WAS PLACED.

| Date. | Highest during day. | Lowest on night following. | Location of concrete placed each day. |
|---|---|---|---|
| October 27, 1914 | 44° | 33° | Station 22+50 to 24+30 |
| November 4, 1914 | 76° | 51° | Station 24+30 to 26+40 |
| November 7, 1914 | 70° | 38° | Station 26+40 to 28+20 |
| November 9, 1914 | 40° | 30° | Station 28+20 to 30+90 |
| November 10, 1914 | 46° | 39° | Station 30+90 to 33+90 |
| November 11, 1914 | 57° | 39° | Station 33+90 to 36+90 |
| April 17, 1915 | 82 | 67° | Station 36+90 to 39+90 |
| April 20, 1915 | 57° | 51° | Station 39+90 to 43+90 |
| April 22, 1915 | 57° | 51° | Station 43+20 to 45+00 |

The minimum temperature at which concrete was placed was 34°.

NOTE—These temperatures are taken from the U. S. Weather Bureau Reports, and are from one to three degrees higher than the actual temperatures on Oxford Road, due to its exposed condition.

## SECTION 3.
From Station 45+00 to 67+00

Composition of Concrete:
1 part Portland cement; 2 parts trap rock [illegible], 3 parts trap rock [illegible] a 1½ inch ring and retained on a ¼ inch screen.

From Station 53+10 to 67+50 a mixture of fine and coarse grit was used in the proportions of one-half coarse and one-half fine. In the remainder of the section regular trap rock screenings were used.

Joints:
From Station 45+00 to 50+10 [illegible]
From Station 50+10 to 67+10—bituminous joints.

Treatment of Surface:
From Station 45+00 to 55+50 [illegible]
From Station 55+50 to 58+50 Tarvia.
From Station 58+50 to 61+50 Ugite.
From Station 61+50 to 64+50—Asphalt Cut-back.
From Station 64+50 to 67+50—Unionite.

## COST PER SQUARE YARD

| | Per sq. yd. |
|---|---|
| Preparation of subgrade | $0.0875 |
| Concrete pavement | 1.2061 |
| Shoulders | 0.0408 |
| | $1.3344 |
| Bituminous top—Tarvia | [illegible] |
| Bituminous top—Ugite | 0.1444 |
| Bituminous top—Asphalt Cut-back | 0.0783 |
| Bituminous top—Unionite | 0.2153 |
| Preparation of subgrade, concrete pavement and bituminous top—Tarvia | 1.4256 |
| Preparation of subgrade, concrete pavement and bituminous top—Ugite | 1.4556 |
| Preparation of subgrade, concrete pavement and bit. top—Asphalt Cut-back | 1.3719 |
| Preparation of subgrade, concrete pavement and bituminous top—Unionite | 1.5089 |

## DETAILED COST PER SQUARE YARD.

### Preparation of Subgrade.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Scarifying | $ 22.25 | $0.0057 |
| Shaping | 344.23 | 0.0883 |
| Rolling | 16.85 | 0.0035 |
| | $383.33 | $0.0875 |

### Concrete Pavement.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Portland cement—1277 bbls. @ $1.60 | $2 043.20 | $0.4665 |
| Trap rock grit { 83.5 tons @ $2.00 / 425.9 tons @ $1.70 } | 167.00 / 744.03 | 0.2005 |
| Trap rock { 643.9 tons @ $1.72 / 57.0 tons @ $1.60 } | 1,107.51 / 91.20 | 0.2737 |
| Forms: Steel and wooden, depreciation | 44.00 | 0.0100 |
| Labor | 114.40 | 0.0261 |
| Joints: Bituminous, 57 | 42.53 | 0.0097 |
| Steel, 15 | 44.80 | 0.0102 |
| Superintendence | 72.00 | 0.0164 |
| Labor: concreting | 411.90 | 0.0941 |
| Covering with dirt | 23.10 | 0.0052 |
| Removing dirt | 8.90 | 0.0021 |
| Pipe line | 61.25 | 0.0140 |
| Sprinkling | 3.75 | 0.0008 |
| Overhead charges for this section alone | 32.79 | 0.0303 |
| Miscellaneous expenses, salaries, coal, etc | 190.60 | 0.0435 |
| 4380 sq. yds. @ $1.2061 | $5,282.96 | $1.2061 |

### Shoulders.

Labor: 2,000 square yards @ $0.0480 ..... $81.63

Actual time for laying concrete:

{ 767 cu. yds. / 4380 sq. yds. } { 7 days, 8 hours, or an average of { 98.25 cu. yds. / 561.5 sq. yds. } per day.

Highest daily yardage—660 square yards.

### Bituminous Wearing Surface—Tarvia.
Station 55+50 to 58+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Tarvia B, paint coat, 168 gallons @ $0.09 | $15.12 | $0.0251 |
| Tarvia A, first coat, 168 gallons @ $0.085 | 14.28 | 0.0238 |
| Trap rock chips, 3 tons @ $1.68 | 5.04 | 0.0084 |
| Tarvia A, second coat, 210 gallons @ $0.085 | 17.85 | 0.0298 |
| Trap rock chips, 6 tons @ $1.68 | 10.03 | 0.0168 |
| Extra chips, 3.9 tons @ $1.68 | 6.55 | 0.0109 |
| Labor | | |
| Hauling chips | 3.72 | 0.0062 |
| Sweeping concrete | 2.00 | 0.0034 |
| Spreading chips | 6.00 | 0.0100 |
| 600 sq. yds. @ $0.1344 | $80.64 | $0.1344 |

### Bituminous Wearing Surface—Ugite.
Station 58+50 to 61+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Ugite A—80 gallons @ $0.09 | $ 7.20 | $0.0120 |
| Trap rock chips, 3 tons @ $1.68 | 5.04 | 0.0084 |
| Ugite No. 3—first application, 195 gallons @ $0.10 | 19.50 | 0.0324 |
| Trap rock chips, 6 tons @ $1.68 | 10.08 | 0.0168 |
| Ugite No. 3—second application 210 gallons @ $0.10 | 21.00 | 0.0350 |
| Trap rock chips, 6 tons @ $1.68 | 10.08 | 0.0168 |
| Labor | | |
| Hauling chips | 3.72 | 0.0062 |
| Cleaning concrete | 1.00 | 0.0017 |
| Spreading chips | 7.05 | 0.0118 |
| Rolling | 2.00 | 0.0034 |
| 600 sq. yds. @ $0.1444 | $86.67 | $0.1444 |

### Bituminous Wearing Surface—Asphalt Cut-back.
Station 61+50 to 64+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Paint coat, 78 gallons @ $0.10 | $ 7.80 | $0.0130 |
| Second coat, 170 gallons @ $0.10 | 17.00 | 0.0282 |
| Trap rock chips, 8 tons @ $1.68 | 13.44 | 0.0224 |
| Labor | | |
| Hauling chips | 3.72 | 0.0062 |
| Sweeping concrete | 2.00 | 0.0034 |
| Spreading chips | 2.00 | 0.0034 |
| Rolling | 1.00 | 0.0017 |
| 600 sq. yds. @ $0.0783 | $46.96 | $0.0783 |

### Bituminous Wearing Surface—Unionite.
Station 64+50 to 67+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Paint coat, 78 gallons @ $0.10 | $ 7.80 | $0.0130 |
| Rock asphalt, 3.6 tons @ $15.00 | 54.00 | 0.0900 |
| Trap rock chips, 3.8 tons @ $2.00 | 7.60 | 0.0127 |
| Asphaltic cement, 550 lbs. @ $0.01 | 5.50 | 0.0092 |

| | | |
|---|---|---|
| Labor | | |
| Cleaning concrete | 13.20 | 0.0219 |
| Hauling material | 9.90 | 0.0165 |
| Rolling | 1.80 | 0.0030 |
| Erecting temporary plant | 6.00 | 0.0100 |
| Labor | 23.40 | 0.0390 |
| 600 sq. yds. @ $0.2153 | $129.20 | $0.2153 |

### TABLE OF TEMPERATURES OF DAYS CONCRETE WAS PLACED.

| Date. | Highest during day. | Lowest on night following. | Location of concrete placed each day. |
|---|---|---|---|
| December 14, 1914 | 40° | 13° | Station 67+50 to 65+70 |
| December 15, 1914 | 22° | 13° | |
| April 9, 1915 | 72° | 51° | Station 65+70 to 61+80 |
| April 10, 1915 | 66° | 52° | Station 61+80 to 58+80 |
| April 12, 1915 | 57° | 43° | Station 58+80 to 57+30 |
| April 13, 1915 | 59° | 42° | Station 57+30 to 54+00 |
| April 14, 1915 | 68° | 47° | Station 54+00 to 51+00 |
| April 15, 1915 | 70° | 56° | Station 51+00 to 48+00 |
| April 20, 1915 | 57° | 51° | Station 48+60 to 47+40 |
| April 21, 1915 | 56° | 44° | Station 47+40 to 45+60 |

Minimum concreting temperature—34°.

NOTE—These temperatures are taken from the U. S. Weather Bureau Reports and are from one to three degrees higher than the actual temperatures on Oxford Road, due to its exposed condition.

## SECTION 4.
From Station 67+50 to 90+00.

**Composition of Concrete:**

1 part Portland cement; 2 parts trap rock grit; 3 parts limestone, passing a 1½-inch ring and retained on a ¼-inch screen.

In this section the mixture varies from 1-2-3 to 1-2½-2½ and 1-2⅓-2⅔, these two latter mixtures being used when the trap rock grit was oversize, that is, the proportion of stone was reduced and the oversize grit considered coarse aggregate.

**Joints:**

From Station 80+10 to 84+60—steel protected joints.

The last two of these joints were placed at an angle of 30° with the center line of the road.

From Station 67+50 to 80+10—bituminous joints.

From Station 84+60 to 90+00—bituminous joints.

**Treatment of Surface:**

From Station 67+50 to 70+50—Tarvia.
From Station 70+50 to 73+50—Ugite.
From Station 73+50 to 76+50—Asphalt Cut-back.
From Station 76+50 to 79+50—Unionite.
From Station 79+50 to 90+00—Untreated.

### COST PER SQUARE YARD.

| | Per sq. yd. |
|---|---|
| Preparation of subgrade | $0.0739 |
| Concrete pavement | 1.2058 |
| Shoulders | 0.0597 |
| | $1.3394 |
| Bituminous top—Tarvia | $0.1344 |
| Bituminous top—Ugite | 0.1361 |
| Bituminous top—Asphalt Cut-back | 0.0783 |
| Bituminous top—Unionite | 0.2153 |
| Preparation of subgrade, concrete pavement and bituminous top Tarvia | 1.4141 |
| Preparation of subgrade, concrete pavement and bituminous top Ugite | 1.4158 |
| Preparation of subgrade, concrete pavement, and bit. top Asphalt Cut-back | 1.3580 |
| Preparation of subgrade, concrete pavement and bituminous top Unionite | 1.4953 |

### DETAILED COST PER SQUARE YARD.
#### Preparation of Subgrade.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Scarifying | $ 11.98 | $0.0026 |
| Shaping | 306.15 | 0.0680 |
| Rolling | 14.85 | 0.0033 |
| 4,500 square yards @ $0.0739 | $332.98 | $0.0739 |

#### Concrete Pavement.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Portland cement { 324.0 bbls. @ $1.68 / 1070.0 bbls. @ $1.60 | $ 554.32 / 1,712.00 | $0.5014 |
| Trap rock grit { 609.2 tons @ $1.70 fine / 15.1 tons @ $2.00 coarse | $1,035.64 / 30.20 | 0.2367 |
| Limestone, 629.0 tons @ $1.35 | 849.15 | 0.1887 |
| Forms: steel and wooden, deprecation | 44.00 | 0.0098 |
| Labor | 125.41 | 0.0278 |
| Joints: bituminous, 59 | 47.61 | 0.0106 |
| steel, 16 | 48.24 | 0.0107 |
| Superintendence | 90.00 | 0.0200 |
| Labor—concreting | 447.98 | 0.0996 |
| Covering with dirt | 35.43 | 0.0079 |
| Removing dirt | 7.03 | 0.0016 |
| Pipe line | 32.18 | 0.0072 |
| Sprinkling | 3.16 | 0.0007 |
| Overhead charges for this section alone | 182.90 | 0.0407 |
| Miscellaneous expenses, coal, salaries, etc | 190.60 | 0.0424 |
| 4,500 square yards @ $1.2058 | $5,425.85 | $1.2058 |

#### Shoulders.

Labor: 2,000 square yards @ $0.0597 ..... $119.36

Actual time for laying concrete:

{ 787 cu. yds. / 4500 sq. yds. } 9 days, 1 hour, or an average of { 865.0 cu. yds. / 494.5 sq. yds. } per day.

Highest daily yardage—600 square yards.

#### Bituminous Wearing Surface—Tarvia.
Station 67+50 to 70+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Tarvia B, paint coat, 168 gallons @ $0.09 | $15.12 | $0.0251 |
| Tarvia A, first coat—168 gallons @ $0.085 | 14.28 | 0.0238 |
| Trap rock chips, 3 tons @ $1.68 | 5.04 | 0.0084 |
| Tarvia A, second coat, 210 gallons @ $0.085 | 17.85 | 0.0298 |
| Trap rock chips, 6 tons @ $1.68 | 10.08 | 0.0168 |
| Extra chips, 3.9 tons @ $1.68 | 6.55 | 0.0109 |
| Labor | | |
| Hauling chips | 3.72 | 0.0062 |
| Sweeping concrete | 2.00 | 0.0034 |
| Spreading chips | 6.00 | 0.0100 |
| 600 square yards @ $0.1344 | $80.64 | $0.1344 |

#### Bituminous Wearing Surface—Ugite.
Station 70+50 to 73+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Ugite A, 80 gallons @ $0.09 | $ 7.20 | $0.0120 |
| Trap rock chips, 3 tons @ $1.68 | 5.04 | 0.0084 |
| Ugite No. 3, 195 gallons @ $0.10 | 19.50 | 0.0324 |
| Trap rock chips, 6 tons @ $1.68 | 10.08 | 0.0168 |
| Ugite No. 3, 160 gallons @ $0.10 | 16.00 | 0.0266 |
| Trap rock chips, 6 tons @ $1.68 | 10.08 | 0.0168 |
| Materials: | | |
| Hauling chips | 3.17 | 0.0062 |
| Cleaning concrete | 1.00 | 0.0017 |
| Spreading chips | 7.05 | 0.0118 |
| Rolling | 2.00 | 0.0034 |
| 600 square yards @ $0.1361 | $81.66 | $0.1361 |

#### Bituminous Wearing Surface—Asphalt Cut-back.
Station 73+50 to 76+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Paint coat, 78 gal. @ $0.10 | $ 7.80 | $0.0130 |
| Second coat, 170 gallons @ $0.10 | 17.00 | 0.0282 |
| Trap rock chips, 8 tons @ $1.68 | 13.44 | 0.0224 |
| Labor | | |
| Hauling chips | 3.72 | 0.0062 |
| Sweeping concrete | 2.00 | 0.0034 |
| Spreading chips | 2.00 | 0.0034 |
| Rolling | 1.00 | 0.0017 |
| 600 square yards @ $0.0783 | $46.96 | $0.0783 |

#### Bituminous Wearing Surface—Unionite.
Station 76+50 to 79+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Paint coat, 78 gallons @ $0.10 | $ 7.80 | $0.0130 |
| Rock asphalt, 3.6 tons @ $15.00 | 54.00 | 0.0900 |
| Trap rock chips, 3.8 tons @ $2.00 | 7.60 | 0.0127 |
| Asphaltic cement, 550 lbs. @ $0.01 | 5.50 | 0.0092 |
| Labor | | |
| Cleaning concrete | 13.20 | 0.0219 |
| Hauling material | 9.90 | 0.0160 |
| Rolling | 1.80 | 0.0030 |
| Erecting temporary plant | 6.00 | 0.0100 |
| Labor | 23.40 | 0.0390 |
| 600 square yards @ $0.2153 | $129.20 | $0.2153 |

### TABLE OF TEMPERATURES ON DAYS CONCRETE WAS PLACED.

| Date. | Highest during day. | Lowest on night following. | Location of concrete placed each day. |
|---|---|---|---|
| November 14, 1914 | 62° | 50° | Station 90+00 to 83+80 |
| November 21, 1914 | 44° | 26° | Station 88+80 to 87+00 |
| November 23, 1914 | 40° | 28° | Station 87+00 to 86+40 |
| November 30, 1914 | 57° | 47° | Station 86+40 to 85+20 |
| December 1, 1914 | 50° | 45° | Station 67+50 to 69+30 |
| December 3, 1914 | 63° | 37° | Station 69+30 to 72+00 |
| December 10, 1914 | 39° | 34° | Station 72+00 to 74+70 |
| December 11, 1914 | 41° | 34° | Station 74+70 to 77+70 |
| December 12, 1914 | 52° | 35° | Station 77+70 to 80+10 |
| April 6, 1915 | 62° | 45° | Station 80+10 to 81+90 |
| April 7, 1915 | 62° | 44° | Station 81+90 to 84+30 |
| April 27, 1915 | 93° | 50° | Station 84+30 to 85+20 |

Minimum concreting temperature—34°.

NOTE—These temperatures are taken from the U. S. Weather Bureau Reports, and are from one to three degrees higher than the actual temperatures on Oxford Road, due to its exposed condition.

## SECTION 5.
From Section 90+00 to 112+50.

**Composition of Concrete:**

1 part Portland cement; 1 part sand; 1 part trap rock grit; 3 parts trap rock passing a 1½-inch ring and retained on a ¼-inch screen.

**Joints:**

From Station 90+60 to 96+30—steel protected joints.
From Station 90+00 to 96+30—bituminous.
From Station 96+30 to 112+50—bituminous.

**Treatment of Surface:**

From Station 90+00 to 100+50—untreated.
From Station 100+50 to 103+50—Tarvia.
From Station 103+50 to 106+50—Ugite.
From Station 106+50 to 109+50—Asphalt Cut-back.
From Station 109+50 to 112+50—Unionite.

### COST PER SQUARE YARD.

| | Per. sq. yd. |
|---|---|
| Preparation of subgrade | $0.0170 |
| Concrete pavement | 1.2566 |
| Shoulders | 0.0509 |
| | $1.4145 |
| Bituminous top—Tarvia | $0.1344 |
| Bituminous top—Ugite | 0.1319 |
| Bituminous top—Asphalt Cut-back. | 0.0783 |
| Bituminous top—Unionite | 0.2153 |
| Preparation of subgrade, concrete pavement and bituminous top Tarvia | 1.4980 |
| Preparation of subgrade, concrete pavement and bituminous top Ugite | 1.4955 |
| Preparation of subgrade, concrete pavement and bit. top Asphalt Cut-back | 1.4419 |
| Preparation of subgrade, concrete pavement and bituminous top Unionite | 1.5789 |

### DETAILED COST PER SQUARE YARD.
#### Preparation of Subgrade.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Scarifying | $ 21.75 | $0.0046 |
| Shaping | 467.25 | 0.0984 |
| Rolling | 19.13 | 0.0040 |
| 4,750 square yards @ $0.1070 | $508.13 | $0.1070 |

#### Concrete Pavement.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Portland cement { 1321.0 bbls. @ $1.60 / 142.0 bbls. @ $1.68 | $2,113.60 / 238.56 | $0.4957 |
| Jersey gravel { 248.4 tons @ $1.20 / 25.8 tons @ $1.25 | 298.08 / 32.25 | 0.0696 |
| Trap rock grit { 101.8 tons @ $2.00 coarse / 203.5 tons @ $1.79 fine | 203.60 / 345.95 | 0.1158 |
| Trap rock { 285.5 tons @ $1.72 / 473.5 tons @ $1.55 / 75.5 tons @ $1.60 | 491.06 / 733.93 / 120.80 | 0.2835 |
| Form: steel and wooden—depreciation | 44.00 | 0.0098 |
| Labor | 131.51 | 0.0277 |
| Joints: bituminous, 58 | 52.71 | 0.0111 |
| steel, 19 | 61.48 | 0.0129 |
| Superintendence | 77.40 | 0.0164 |
| Labor—concreting | 504.41 | 0.1062 |
| Covering with dirt | 22.58 | 0.0048 |
| Removing dirt | 12.57 | 0.0026 |
| Pipe line | 40.50 | 0.0085 |
| Overhead charges for this section alone | 239.94 | 0.0506 |
| Miscellaneous expenses—coal, salaries, etc | 190.60 | 0.0404 |
| 4746.12 square yards @ $1.2566 | $5,965.51 | $1.2566 |

**Shoulders.**

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Labor: 2050 square yards @ 0.0509 | $104.35 | |
| Actual time for laying concrete: { 830.27 cu. yds. / 4176.12 sq. yds. } 9 days, 8 hours, or an average of { 84.75 cu. yd. / 484.3 sq. yd. } per day. | | |
| Highest daily yardage—600 square yards. | | |

**Bituminous Wearing Surface—Tarvia.**
Station 100+50 to 103+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Tarvia B—paint coat, 160 gallons @ $0.09 | $15.13 | $0.0251 |
| Tarvia A—first coat, 168 gallons, @ $0.085 | 14.28 | 0.0238 |
| Trap rock chips, 3 tons @ $1.68 | 5.04 | 0.0084 |
| Tarvia A—second coat, 210 gallons @ $0.085 | 17.85 | 0.0293 |
| Trap rock chips, 6 tons @ $1.68 | 10.08 | 0.0168 |
| Extra chips, 3.9 tons @ $1.68 | 6.55 | 0.0109 |
| Labor | | |
| Hauling chips | 3.72 | 0.0062 |
| Sweeping concrete | 2.00 | 0.0034 |
| Spreading chips | 6.00 | 0.0100 |
| 600 square yards @ $0.1344 | $80.64 | $0.1344 |

**Bituminous Wearing Surface—Ugite.**
Station 103+50 to 106+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Ugite A—80 gallons @ $0.09 | $ 7.20 | $0.0120 |
| Trap rock chips—3 tons @ $1.68 | 5.04 | 0.0084 |
| Ugite No. 3—170 gallons @ $0.10 | 17.00 | 0.0282 |
| Trap rock chips—6 tons @ $1.68 | 10.08 | 0.0168 |
| Ugite No. 3—160 gallons @ $0.10 | 16.00 | 0.0266 |
| Trap rock chips—6 tons @ $1.68 | 10.08 | 0.0168 |
| Labor | | |
| Hauling chips | 3.71 | 0.0062 |
| Cleaning concrete | 1.00 | 0.0017 |
| Spreading chips | 7.05 | 0.0118 |
| Rolling | 2.00 | 0.0034 |
| 600 square yards @ $0.1319 | $79.16 | $0.1319 |

**Bituminous Wearing Surface—Asphalt Cut-back.**
Station 106+50 to 109+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Paint coat, 78 gallons @ $0.10 | $ 7.80 | $0.0130 |
| Second coat, 170 gallons @ $0.10 | 17.00 | 0.0282 |
| Trap rock chips, 8 tons @ $1.68 | 13.44 | 0.0224 |
| Labor | | |
| Hauling chips | 3.72 | 0.0062 |
| Sweeping concrete | 2.00 | 0.0034 |
| Spreading chips | 2.00 | 0.0034 |
| Rolling | 1.00 | 0.0017 |
| 600 square yards @ $0.0783 | $46.96 | $0.0783 |

**Bituminous Wearing Surface—Unionite.**
Station 109+50 to 112+50.

| | Total cost. | Cost per sq. yd. |
|---|---|---|
| Materials: | | |
| Paint coat, 78 gallons @ $0.10 | $ 7.80 | $0.0130 |
| Rock Asphalt, 3.6 tons @ $15.00 | 54.00 | 0.0900 |
| Trap rock chips, 3.8 tons @ $2.00 | 7.60 | 0.0127 |
| Asphaltic cement, 550 lbs. @ $0.01 | 5.50 | 0.0092 |
| Labor: | | |
| Cleaning concrete | 12.30 | 0.0219 |
| Hauling material | 9.90 | 0.0165 |
| Rolling | 1.80 | 0.0030 |
| Erecting temporary plant | 6.00 | 0.0100 |
| Labor | 23.40 | 0.0390 |
| 600 square yards @ $0.2153 | $129.20 | $0.2153 |

**TABLE OF TEMPERATURES ON DAYS CONCRETE WAS PLACED.**

| Date. | Highest during day. | Lowest on night following. | Location of concrete placed each day. |
|---|---|---|---|
| November 14, 1914 | 62° | 50° | Station 90+00 to 90+60 |
| November 16, 1914 | 62° | 30° | Station 90+60 to 91+20 |
| November 17, 1914 | 40° | 29° | Station 91+20 to 93+30 |
| November 19, 1914 | 39° | 60° | Station 93+30 to 95+10 |
| November 20, 1914 | 44° | 26° | Station 95+10 to 97+80 |
| November 24, 1914 | 39° | 33° | Station 97+80 to 100+20 |
| November 25, 1914 | 40° | 33° | Station 100+20 to 103+20 |
| November 26, 1914 | 60° | 49° | Station 103+20 to 105+90 |
| November 27, 1914 | 64° | 35° | Station 105+90 to 108+78 |
| November 28, 1914 | .. | .. | Station 108+78 to 111+08 |
| November 30, 1914 | 57° | 47° | Station 111+08 to 111+28 |

Minimum concreting temperature—34°.

NOTE—These temperatures are taken from the U. S. Weather Bureau reports and are from one to three degrees higher than the actual temperatures on Oxford Road, due to its exposed condition.

**OXFORD PIKE SERVICE TEST ROAD.**
**SCHEDULE OF WAGES PAID.**

| | Per day |
|---|---|
| Superintendent | $ 4.50 |
| Foreman | 3.00 |
| Carpenters | 3.60 |
| Roller engineers | 4.25 |
| Pavers (straight time men) | 2.50 |
| Pavers (straight time men) | 3.00 |
| Watchmen | 1.50 |
| Laborers | 1.60 |
| Laborers | 1.75 |
| Single teams | 3.50 |
| Double teams | 5.50 |
| Engineers | 3.00 |
| Engineers (Union) | 4.25 |
| Roller, ten-ton, with engineer | 15.00 |

Equipment use:
One 10-ton roller.
One 20 cu. ft. Ransome mixer.
One 20 cu. ft. Foote mixer.
One 5-ton roller.
Crusher Plant—Output daily 50 tons.

**TRAFFIC CENSUS.**
**OXFORD PIKE SERVICE TEST ROAD.**

| Character of Traffic | Fri. 8.13 Clear | Sat. 8.14 Clear | Sun. 8.15 showers | Mon. 8.16 Clear |
|---|---|---|---|---|
| Horse without vehicle | 3 | 1 | 2 | 2 |
| Horse vehicle, light | 20 | 27 | 27 | 35 |
| Horse vehicle, heavy | 60 | 36 | 18 | 48 |
| Two horse vehicle, light | 11 | .. | 2 | .. |
| Two-horse vehicle, heavy | 87 | 69 | 16 | 74 |
| Three-horse vehicle | 1 | 1 | .. | .. |
| Motorcycles and bicycles | 98 | 108 | 96 | 65 |
| Two-passenger cars | 38 | 41 | 89 | 39 |
| Touring cars | 212 | 247 | 516 | 216 |
| Light freight trucks | 8 | 10 | 23 | 15 |
| Medium freight truck | 12 | 5 | 3 | 11 |
| Heavy freight trucks | 6 | 1 | 1 | 7 |
| Miscellaneous heavy traffic | .. | 4 | .. | 2 |
| Totals | 557 | 550 | 743 | 514 |

* * *

## Report of Ohio County, West Virginia, Department of Roads

### June 1, 1915 to June 30, 1916

During this year the following roads below with the cost thereof, were resurfaced:

Wheeling and Fairmont Pike, 1,751 square yards. Bituminous macadam, penetration method. Total cost, $1,870.90.

Wheeling and Elm Grove Road, 6,713 square yards. Bituminous macadam, penetration method, at a total cost of $7,-241.47.

Wheeling and Ridge Road, 8,321 square yards. Bituminous macadam, penetration method, total cost, $9,622.99.

Greggs, Clinton, and Potomac Road, 7,722 square yards. Bituminous macadam, penetration method. Total cost, $7,-686.90.

National Road, 20,000 square yards. Asphaltic concrete over old brick and concrete, $23,000.

Concrete base for widening at different locations on above work, $6,000.

All of the bituminous macadam, penetration method was used in resurfacing old macadam roads. Using as a foundation, the macadam which had been in service for several years.

In addition to the above work, the county crushed with their own equipment about 14,000 cubic yards of limestone, for use on the various roads of the county. Most of this crushed limestone was used in building eleven (11) miles of waterbound road, which was built under the direct supervision of the road department of this county.

We now have quarried and ready to crush 10,000 cubic yards of limestone, with approximately 10,000 cubic yards additional contracted for.

We have completed one (1) fifty-foot reinforced concrete arch bridge, over Little Wheeling Creek, at a cost of $2,389 for the bridge and $800 for the walls and approaches, making the total cost $3,189, and now have under construction one (1) double arch reinforced concrete bridge over Wheeling Creek, each span being fifty feet in the clear.

In addition to the above bridges we built concrete superstructures on the old stone abutments of twelve (12) bridges. These concrete structures replaced old wooden bridges, the total cost for the twelve (12) being $3,739.69.

We have also purchased a site of approximately three (3) acres. Have erected thereon a frame and corrugated iron storage building, thirty feet by sixty-four feet, which is used for a storage and repair shed for the machinery, used in the construction, maintenance, and repair of the county roads.

Ten thousand lineal feet of twelve-inch culvert was installed during the last fiscal year. A large part of which was corrugated iron. Also ten corrugated iron culverts, from thirty to forty feet in length, and thirty to sixty inches in diameter were placed.

In addition to the above new construction, the regular maintenance work was not neglected, as all of the (240) miles of road in the county have been ditched, culverts opened, slips removed, weeds cut and a large quantity of napped stone used for patch work. The total cost of all work with stone such as the purchase of napped stone, the spreading of the same and in the spring the raking off of loose stone, was $21,907.75.

The cost of cleaning ditches and opening culverts was $7,-054.85.

The cost of installing new culverts, cleaning, and patching old ones $3,928.31.

The cost of removing the larger slips, total $1,865.49, for the year.

Small concrete walls and deflecting wings were constructed at different points along the streams, the total cost of which was $7,079.97.

This, I believe, will give you a general idea of the work accomplished in this county during the year ending June 30, 1916.

This county has no bonded indebtedness for road purposes.

* * *

## Founding and Fostering the Michigan State Highway Department

### By Hy Waigh

THE Michigan State Highway Department presents a history remarkable for its small beginning and steady growth. An act of the Legislature of 1903, "to create a separate and distinct bureau in the State to be known as the State Highway Department," was the first attempt to legalize the contribution of State Aid in the building of public wagon roads.

This act was along the lines recommended by a committee appointed for that purpose by the legislature of 1901. This committee, of which Senator Horatio S. Earle was chairman, consisted of two senators, three representatives, and two members of the State Board of Agriculture, with whom the present State Highway Commissioner, Mr. Frank F. Rogers, served as engineer. This committee, although compelled by the legislature to serve "without pay or expense to the State," did a vast amount of good work, assisted financially and otherwise by public spirited persons, good roads associations, and makers of road machinery.

The "Bureau" of 1903 resembled a commode more than it did a chiffonier but it probably looked pretty good at that time. That time, by the way, was the time of the "curved dash, one-lunger," to which the new road law might also be compared.

The law of 1903 carried an appropriation of $5,000 for each of the fiscal years ending June 30, 1904, and 1905. No part of this fund was available for the purpose of paying State rewards, but was used mainly for the purpose of educating the highway officials of the townships, counties, and villages and supervising their work.

The appointment of Hon. H. S. Earle, as the first State Highway Commissioner naturally followed. The hopes of years at last seemed realized but the law was declared unconstitutional. In 1905, however, the Legislature submitted a constitutional amendment providing for a State Highway Department, which was adopted by the people by an overwhelming majority, and followed it with a new law creating a new department. This law provided $20,000 for the payment of rewards for the 1906 fiscal year and $50,000 for the 1907 fiscal year, and $10,000 for each of these years for department expenses. Compared with the law of 1903, it was a "two cylinder" law.

Mr. Earle again received the appointment of State Highway Commissioner, and he in turn appointed Mr. Rogers deputy and engineer. The entire force of the department for the first two years was from three to five persons. During the first year only eighteen miles of road were built and less than sixty-five miles the second year. There was an unspent balance of the appropriation for rewards carried forward to add to the amount which was voted by the 1907 Legislature for the two following fiscal years, namely, $100,00 for 1908, and $150,000 for 1909—amounts which suggest that the department had reached the "Ford" stage of its development. The mileage built in 1908 was 100, and in 1909 over 160, but did not exhaust the funds.

The four fiscal years following, under Commissioner Ely and Deputy Commissioner Rogers, show even greater progress. At the close of the fiscal year ending June 30, 1912, the entire appropriation which had been made up to that time, amounting to $835,000, had been paid out for State rewards, and a total of 1,231.25 miles of road constructed.

The Legislature of 1911, appropriated for each of the two years following $250,000, of which $235,000 was for rewards and $15,000 for expenses, but when Governor Osborn signed the act, he cut $5,000 each year from the expense item, leaving only $10,000 per year, the same as it had been in previous years, which might account for some of the lack of growth in 1912. This temporary check was overcome in 1913, and the fund again gave out. The Legislature provided a deficiency fund of $150,000—$1,500 for expenses and $148,500 for rewards. The total reward fund for 1913 was $383,500, of which $329,392 was paid for 523 miles of road or an average reward of $630 per mile. The "real automobile" is typical of this period.

The year 1914 marked a vast change in the kind and amount of work performed, due mainly to the passage of the Trunk Line Act which carried with it a biennial appropriation of half a million dollars. This Act provided for the locating of 3,000 miles of trunk line highways which would serve the whole State, and added greatly to the powers and duties of the department, notably in the building of bridges of over thirty foot span. This year, Mr. Rogers, who had served as deputy commissioner for the past eight years became the head of the department. In addition to the trunk line funds, the appropriation for 1914 was $450,000 for rewards and expenses.

For the 1915 fiscal year, $20,000 was provided for expenses, and, in lieu of a specific sum for rewards, it was expected that the net revenues from the sale of automobile licenses under the provisions of the 1913 motor vehicle law would be available. This law was declared unconstitutional, however, which necessitated a deficiency appropriation of $600,000.

The Legislature now found that the Highway Department had grown into the "six cylinder class" and the "up-keep" was greater. As a consequence, $975,000 was appropriated for 1916, of which $350,000 was the trunk line fund. Yet a balance of less than $60 remained from the 1916 fiscal year which has just closed.

As a result of this expenditure, Michigan now has approximately 4,000 miles of State rewarded roads or, as is estimated, nearly one-fifth of the mileage necessary to reach every village, town, and city in the State. These roads, are, for the most part, located on the main routes leading out from the various market places of the State but have not extended far enough to be connected at the ends.

The increase in the mileage and appropriations is readily seen from the following table.

| Year | Miles Built | Total Fund | Trunk Line Fund | Expenses |
|---|---|---|---|---|
| 1906 | 18.00 | $ 30,000 | | $10,000 |
| 1907 | 64.25 | 60,000 | | 10,000 |
| 1908 | 96.50 | 110,000 | | 10,000 |
| 1909 | 161.00 | 160,000 | | 10,000 |
| 1910 | 204.50 | 150,000 | | 10,000 |
| 1911 | 305.25 | 150,000 | | 10,000 |
| 1912 | 382.75 | 245,000 | | 10,000 |
| 1913 | 523.00 | 383,500 | | 10,000 |
| 1914 | 696.25 | 650,000 | $200,000 | 18,000 |
| 1915 | 757.54 | 920,000 | 300,000 | 20,000 |
| 1916 | 728.57 | 975,000 | 350,000 | 25,000 |
| Total | 3,936.41 | $3,833,500 | $850,000 | $143,000 |

For a time it was problematical what the State would be able to do in the coming year. An appropriation of $550,000 for trunk line expenses and $30,000 for expenses was made for the 1917 fiscal year. A new automobile tax law was passed which provided that the counties and the State Highway Department should share equally all revenue derived from the licensing of automobiles within the State. This law was expected to furnish funds with which to pay rewards but its constitutionality was hotly contested in the courts. It was declared constitutional, however, and $767,602 was credited to the State Highway funds on July 1 of this year. Thus over a million and a quarter dollars are available to meet the State's share of the cost of constructing the roads to be built during 1917, which, it is estimated, will total 1,500 miles.

* * *

## Four Years of Concrete Road Construction in Lake County, Ohio

### County Highway Superintendent Summarizes Work

Abstract of Address of H. P. Cumings before Ohio Engineering Society

H. P. Cumings, Painesville, county highway superintendent of Lake County, Ohio, addressed a recent meeting of the Ohio Engineering Society on the subject, "The Concrete Roads of Lake County." An abstract of this address follows:

The first concrete road in Lake County, Ohio, was built during the summer of 1912 under State specifications and State supervision. It was built on the road leading south from the village of Madison on what was then known as the Madison-Southern road but now known as the Chardon-Madison road.

A considerable portion of the tar surface (less than half) has disappeared, going off in small patches and leaving the pavement with a mottled appearance. The surface of the concrete where the tar has disappeared is showing no marked amount of wear. A few cracks have appeared, perhaps a half dozen would come close to covering the number. The pavement is in good condition, and is the pavement that convinced me that concrete can be laid on a clay soil and not break up from the effects of freezing and thawing.

The second concrete pavement was laid in Lake County in the summer of 1913, on what was known as the Weeds Corner Extension road, being a section of the Painesville-Warren road.

In the summer of 1914 an extension of this pavement was built. This extension was 1.34 miles in length and was similar in every way to the one just described, except that the top course was a 1:1:2 concrete; slag was used for the coarse aggregate in the base and silica gravel in the top for about one-half of the job and hard limestone in the top for the reminder. No tar was used on the surface of this pavement. The surface is to-day in almost perfect condition.

Also in the summer of 1914, 9.80 miles of county road were built in the township of Madison, under two contracts, one for 5.43 miles on the Madison-South Ridge road and one for 4.37 miles on the Lake-River road. The south Ridge road, as its



name indicates, is laid on the southerly one of three natural sandy bridges running in an easterly and westerly direction through part of the county and very nearly paralleling the south shore of Lake Erie. While this ridge is for the most of a sandy and gravelly nature, yet numerous spongy and treacherous spots occur in it, so that while it was a deep sand bed for traffic in the summer if offered many mires in the wet season. The longitudinal grades on the greater portion of this road are light. Drainage was provided for by open ditches, one and one-half feet deep, by storm water sewers with numerous inlets and by tile drains discharging into the inlet basins. A street car track lies along one side of this road for about one-half its length. A four-inch drain was laid the entire length of this track in the center of the strip between the track and the pavement, and thirty inches below the surface grade of the pavement.

Some ninety blocks were reinforced with American Steel & Wire Company's Triangle Mesh Number 28. These blocks were in wet or springy places, or on fills, or where sewer trenches had been excavated. Out of these ninety blocks about a half dozen have fine cracks. These have not opened up so as to cause any damage whatever.

In one section seventeen blocks were reinforced because of a fill of from one to four feet in depth. Not a crack has appeared in any of these blocks. In passing through the business section of Madison village this road was paved from forty to forty-five feet in width. These blocks are all reinforced. Only a few cracks have appeared and none have opened up. One has to look closely to discover them.

The first half mile of this pavement was laid with three-eighths-inch expansion strips at the joints, with no armor plates. The edges of the blocks at these joints have rounded off, but the ravelling has increased but very little since the first few months. After the first half mile was laid all joints were armored with Kahn plates. These joints are in practically perfect condition except where the concrete was left too high and floated over the plates, in which cases the edges of the blocks



have rounded down to the plates. Very little if any chipping back of the plates has occurred.

The Lake-River road runs in a north and south direction and extends from Lake Erie on the north to the Grand River on the south. The part of this road that was paved is a section one mile in length running south from the South Ridge road at Madison village and a section three and one-half miles in length running north from this village. The greater part of the south mile is on clay soil. The north three and one-half miles are on a lighter and more sandy soil with numerous wet and quick-sandy places. The first mile north from the village has always been an exceptionally difficult piece of road to keep in a passable condition. A longitudinal grade sufficient for good drainage exists on nearly the entire length of this four and one-half miles.

As soon as the last block laid was three weeks old, hauling over it of material for the two and one-half miles north of it was begun.

I have observed that a traction engine with lugs on the wheels which would chip the pavement in passing over it the



first season after it was opened to traffic, will now pass over it without leaving a mark, showing conclusively that the pavement is not at its best for a long time after it is laid and that traffic should be kept off from it as long as a long-suffering public can made to suffer. Except for this one mile, the surface of the pavement on the Lake River Road is practically as perfect, so

far as abrasive wear is concerned, as the day it was opened to traffic.

As on the other hand, the length of the blocks was thrity-three and one-third feet. Except for the first half mile laid, all joints were protected with Kahn plates, a three-eighths expansion strip being placed between the plates. These joints are in practically perfect condition to-day. At some of the wet and treacherous places, blocks were reinforced with rib metal reinforcement size number six, manufactured by the Trussed Concrete Steel Company. In all nineteen blocks were so reinforced. Not one of these blocks shows any crack or defect of any kind.

Our experinece with the Madison pavements, not only in the matter of the cracking of concrete, but also because of difficulties we experienced in securing a uniform grade of pebbles for a coarse aggregate, caused us to use only a crushed rock for the coarse aggregate in the next pavement to be built in Lake County, and also caused us to reinforce all concrete pavement thereafter built. Following out this decision, contracts were let in the spring of 1915 for paving with concrete three roads in the township of Perry, aggregating 9.73 miles as follows: the Perry-South Ridge road, 5.12 miles, which is an extension westerly of the Madison-South Ridge road; the Narrows-Center road, 2.38 miles, a road running northwesterly from the South Ridge road and passing through the village of Perry, and the Call road, 2.23 miles, running northeasterly from the Narrows road.

The first two of the above named roads were completed during the past season. The concrete pavement is sixteen feet wide, six inches thick at the edges, and seven and one-half inches in the center, the surface having a crown of one and one-half inches. Soil conditions were similar to those in the Madison work and the same attention was given to drainage as on that work. The concrete was laid in two courses, the base being four inches thick at the edges and five inches thick at the center. The top course is two inches thick at the edges and two and one-half inches thick at the center. A 1 : 2½ : 4 concrete was used in the base, the coarse aggregate being a hard limestone. The top is 1 : 1½ : 2½ concrete, the coarse aggregate being trap rock, graded in size from one and one-fourth inches. The block are thrity-three and one-third feet in length. Joints are armored with Kahn plates separated with three-eighths-inch expansion strips. Every block is reinforced with Kahn Road Mesh Number 25 placed in the upper part of the base course. The sand used in the greater part of this work was from a local pit and tests made upon it from time to time showed it to be of excellent quality and well graded.

These pavements have now gone through their first winter. It is, of course, too early to be able to say what they will eventually show. Yet they have already passed through four periods of moderate freezing, one period reaching to about the zero point, followed each time by a sudden thaw and complete break up. Up to the present time I have not been able to discover one crack or defect of any kind in the entire 7.50 miles, though I have made several careful inspection trips over them. Neither has any one reported any crack or defect to me.

A concrete pavement, to be worth while, must be constructed with first-class workmanship and first-class material. Nothing less will do. But past experience and experiments indicate that, with these two ingredients, the concrete pavement will make for itself in the coming years, a worthy record.

* * *

## State Convict Road Work in Pottawatomie County, Oklahoma

OKLAHOMA has recently undertaken the use of the State convicts in the construction of the principal roads of the State. Among the first to avail themselves of this opportunity were the commissioners of Pottawatomie County. The work in this county is being done in co-operation between the county, the State, and the United States Office of Public Roads and Rural Engineering, the county furnishing the necessary funds, a portion of the equipment, and four teams, the State furnishing most of the equipment, seven teams, fifty negro prisoners, four employes, and a small traction engine. The work is being done under the immediate supervision of an engineer of the United States Office of Public Roads and Rural Engineering.

This outfit is building a graded road extending entirely through the county from north to south, a distance of approximately thirty-five miles, and passing through the most important towns in the county. Sand clay and gravel surfaces will be built where such construction is necessary.

The work is being done to a high standard with a view of furnishing a model of the best type of earth road and a demonstration of what can be done with State convict labor, together with the costs of the same. All drainage structures are being built of concrete, care being taken to insure the proper size of waterway opening and proper type of structure for minimum cost at each place. Culverts, under ten feet clear span, are built with a clear roadway of twenty-four feet, or the full width of the roadbed. Headwalls are low. Bridges, over ten feet clear span, are built with a clear roadway of sixteen feet and have rails or balustrades two and a half to three feet high.

The location of the road, north of Tecumseh, the county seat, follows the section lines except at the right angle turns where the corner is rounded to a radius of two hundred feet, which is near the minimum for comfort and safety of automobiles. South of Tecumseh the land is very rough and the section line location will be disregarded and the road located to the best advantage.

The work itself offers very little out of the ordinary except, probably, the type of structure that is used in the flat valleys have a maximum grade of approach of five per cent. or less, where concrete paved crossings are used instead of culverts. This type of construction gives a considerable saving in concrete, form work, steel reinforcing, and earthwork in approach fills. Less than one-third the volume of filling necessary to cover a culvert being sufficient. Such a crossing in this country is dry practically all the time and even when covered with the maximum flood the depth is less than two feet. The longitudinal profile is made flat enough to insure easy riding in a car at any speed up to forty miles per hour. The concrete in these pavements has been placed at a cost of from $0.88 to $1.50 per cubic yard for labor, including all excavation, form work, and seasoning. Concrete in bridges and culverts has cost quite a bit more due to the necessity of employing skilled labor for the form work.

The most interesting and unique item in connection with this work, as with all State convict work in Oklahoma, is the use of trusty prisoners in the road camps. The guards furnished by the State act merely as foremen on the several jobs. In order to get full benefit of the labor of the prisoners the county has hired additional foremen and all prisoners are worked under the several foreman and at various places in the same manner as free labor is worked. The men wear shirt, overalls, and jumpers of various pattern so that the appearance of the men at work is the same as would be presented by free laborers. All teaming is done by prisoners and as a rule they are unaccompanied when sent to town for material and supplies. The regular commissary team being driven by a life-time man.

The men are worked eight hours a day and have the remainder of their time to themselves until nine o'clock when all must be in camp and the lights out. On an average of ten or twelve are permitted to spend Saturday night and Sunday in town where they are better behaved than the native population. A good many get employment from neighboring farmers on Sunday and earn $1.25 and their dinner. The men are healthy, vigorous, and reasonably contented, liking the camp life much better than that at the "Walls" as they call the penitentiary.

The camp has been located in this county since April 3, and there have been no attempts to escape with the exception of a few who have gone to town without permission. Discipline, to these few and to those who are lazy or refractory, is maintained by returning them to the Walls. It has been necessary to return about twelve so far.

The cost to the county of the camp has averaged 27.5 cents per man per day for the convicts and State employes, which is the total cost of feeding, and is all the compensation demanded by the State for the use of the men, team, and equipment. Teams have cost about fifty cents per day. In addition to these expenses the county pays for all material, repairs, and new equipment and hires such skilled labor as is necessary for the concrete work.

The earth work, grading and about 1,500 cubic yards of excavation per mile has cost $150 per mile, including the cost of teams, labor, and fuel for tractor. The teams are used for hauling concrete materials as well as for the grading. The extra men are used in clearing and grubbing, maintenance of the camp and concrete construction.

The total expense to August 1, not counting the purchase of new teams and equipment, has been about $6,000 of which sixty-six per cent. has been expended for materials, freight, and repairs. The remaining thirty-four per cent. has been expended for labor, team feed, and feed for the prisoners. Measured as a percentage of the labor cost the overhead expense has been about fifty per cent. accounted for as follows: camp men fourteen per cent., sick four per cent., Sundays and holidays eighteen per cent., miscellaneous fourteen per cent. Measured as a percentage of total expenditure the overhead is only ten per cent. to twelve per cent.

The quality of labor was rather poor at the start but by weeding out the drags it is now, individually, seventy-five per cent. to ninety per cent. as efficient as good free labor, depending upon the class of work done. The team work being as efficient as that of the majority of contractors outfits.

While it is a little early to draw conclusions as to the advantages of convict labor here, the results so far obtained show a decided saving over the use of free labor. It has also been found that to get the most from the prisoners skilled free men must be employed in sufficient number to supervise four or five units. As many teams should be used as can be economically employed, in this place we could use fifteen to advantage with the fifty prisoners. A high powered traction engine should be used in preference to a small light one. In order to always have useful work for the men it is necessary to have more work undertaken than there are men to perform it, this keeps everyone busy and anxious to finish the job in hand.

* * *

The State Highway Commission of Alabama has just issued its fifth annual report covering the period from March 1, 1915, to April 1, 1916.

# Factors of Apportionment to States under Federal Aid Road Act Appropriation for the Fiscal Year 1917

## Basis of Certificate of Deduction and Apportionment of July 21, 1916

For convenient reference in connection with the certificate of deduction and apportionment issued by the Secretary of Agriculture under date of July 21, 1916, as required by the "Act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes," approved July 11, 1916, the factors of apportionment of $4,850,000 and the amounts apportioned to each State for the fiscal year 1917 are set forth in the following table:

| State | Area as of 1910 United States census | | Population as of 1910 United States census | | Star and rural routes shown by certificate of Postmaster General as of June 30, 1916. | | Percentage apportionment. | Sum apportioned. |
|---|---|---|---|---|---|---|---|---|
| | Square miles. | Percentage. | Population. | Percentage. | Miles. | Percentage. | | |
| Alabama | 51,998 | 1.71796 | 2,138,093 | 2.33311 | 29,615 | 2.39111 | 2.14740 | $ 104,148.99 |
| Arzona | 113,956 | 3.76500 | 204,354 | .22299 | 3,696 | .24997 | 1.41265 | 68,513.52 |
| Arkansas | 53,335 | 1.76214 | 1,574,449 | 1.71806 | 20,245 | 1.63458 | 1.70493 | 82,689.10 |
| California | 158,297 | 5.22999 | 2,377,549 | 2.59441 | 18,823 | 1.51976 | 3.11472 | 151,063.92 |
| Colorado | 103,948 | 3.43435 | 799,024 | .87191 | 10,781 | .87045 | 1.72557 | 83,690.14 |
| Connecticut | 4,965 | .16404 | 1,114,756 | 1.21644 | 6,721 | .54265 | .64104 | 31,099.44 |
| Delaware | 2,370 | .07830 | 202,322 | .22078 | 2,566 | .20718 | .16875 | 8,184.37 |
| Florida | 58,666 | 1.93827 | 752,619 | .82127 | 8,706 | .70292 | 1.15415 | 55,976.27 |
| Georgia | 59,265 | 1.95806 | 2,609,121 | 2.84711 | 43,397 | 3.50386 | 2.76968 | 134,329.48 |
| Idaho | 83,888 | 2.77158 | 325,594 | .35529 | 7,594 | .61314 | 1.24667 | 60,463.50 |
| Illinois | 56,665 | 1.85216 | 5,638,591 | 6.15290 | 69,860 | 5.64048 | 4.55518 | 220,926.23 |
| Indiana | 36,354 | 1.20110 | 2,700,876 | 2.94723 | 52,619 | 4.24844 | 2.79892 | 135,747.62 |
| Iowa | 56,147 | 1.85505 | 2,224,771 | 2.42770 | 58,943 | 4.75904 | 3.01393 | 146,175.60 |
| Kansas | 82,158 | 2.71442 | 1,690,949 | 1.84518 | 53,240 | 4.29858 | 2.95273 | 143,207.40 |
| Kentucky | 40,598 | 1.34132 | 2,289,905 | 2.49877 | 27,113 | 2.18910 | 2.00973 | 97,471.91 |
| Louisiana | 48,506 | 1.60259 | 1,656,388 | 1.80747 | 9,458 | .76364 | 1.39123 | 67,474.66 |
| Maine | 33,040 | 1.09161 | 742,371 | .81008 | 13,566 | 1.09531 | .99900 | 48,451.50 |
| Maryland | 12,327 | .40727 | 1,295,346 | 1.41350 | 11,194 | .90380 | .90819 | 44,047.22 |
| Massachusetts | 8,266 | .27310 | 3,366,416 | 3.67347 | 7,698 | .62153 | 1.52270 | 73,850.95 |
| Michigan | 57,980 | 1.91561 | 2,810,173 | 3.06650 | 49,981 | 4.03545 | 3.00585 | 145,783.72 |
| Minnesota | 84,682 | 2.79782 | 2,075,708 | 2.26504 | 46,384 | 3.74503 | 2.93596 | 142,394.06 |
| Mississippi | 46,865 | 1.54838 | 1,797,114 | 1.96103 | 24,646 | 1.98991 | 1.83311 | 88,905.84 |
| Missouri | 69,420 | 2.29357 | 3,293,335 | 3.59373 | 57,108 | 4.61088 | 3.49939 | 169,720.41 |
| Montana | 146,997 | 4.85664 | 376,053 | .41035 | 10,065 | .81264 | 2.02654 | 98,287.19 |
| Nebraska | 77,520 | 2.56119 | 1,192,214 | 1.30096 | 33,964 | 2.74224 | 2.20146 | 106,770.81 |
| Nevada | 110,690 | 3.65710 | 81,875 | .08934 | 2,935 | .23697 | 1.32780 | 64,398.30 |
| New Hampshire | 9,341 | .30862 | 430,572 | .46985 | 6,444 | .52029 | .43292 | 20,996.62 |
| New Jersey | 8,224 | .27171 | 2,537,167 | 2.76859 | 7,708 | .62234 | 1.22088 | 59,212.68 |
| New Mexico | 122,634 | 4.05171 | 327,301 | .35715 | 5,716 | .46151 | 1.62346 | 78,737.81 |
| New York | 49,204 | 1.62565 | 9,113,614 | 9.94489 | 48,773 | 3.93792 | 5.16949 | 250,720.27 |
| North Carolina | 52,426 | 1.73211 | 2,206,287 | 2.40753 | 36,358 | 2.93553 | 2.35839 | 114,381.92 |
| North Dakota | 70,837 | 2.34039 | 577,056 | .62969 | 21,548 | 1.73978 | 1.56996 | 76,143.06 |
| Ohio | 41,040 | 1.35592 | 4,767,121 | 5.20194 | 61,968 | 5.00328 | 3.85372 | 186,905.42 |
| Oklahoma | 70,057 | 2.31462 | 1,657,155 | 1.80831 | 37,145 | 2.99908 | 2.37400 | 115,139.00 |
| Oregon | 96,699 | 3.19485 | 672,765 | .73413 | 11,621 | .93828 | 1.62242 | 78,687.37 |
| Pennsylvania | 45,126 | 1.49092 | 7,665,111 | 8.36426 | 54,638 | 4.41146 | 4.75555 | 230,644.17 |
| Rhode Island | 1,248 | .04123 | 542,610 | .59210 | 1,093 | .08825 | .24053 | 11,665.71 |
| South Carolina | 30,989 | 1.02385 | 1,515,400 | 1.65362 | 21,851 | 1.76424 | 1.48057 | 71,807.64 |
| South Dakota | 77,615 | 2.56433 | 583,888 | .63715 | 22,362 | 1.80550 | 1.66899 | 80,946.02 |
| Tennessee | 42,022 | 1.38837 | 2,184,789 | 2.38407 | 40,731 | 3.28861 | 2.35368 | 114,153.48 |
| Texas | 265,896 | 8.78496 | 3,896,542 | 4.25195 | 62,181 | 5.02048 | 6.01913 | 291,927.81 |
| Utah | 84,990 | 2.80799 | 373,351 | .40740 | 3,806 | .30730 | 1.17423 | 56,950.15 |
| Vermont | 9,564 | .31599 | 355,956 | .38842 | 8,777 | .70865 | .47102 | 22,844.47 |
| Virginia | 42,627 | 1.40836 | 2,061,612 | 2.24966 | 31,045 | 2.50656 | 2.05486 | 99,660.71 |
| Washington | 69,127 | 2.28389 | 1,141,990 | 1.24615 | 11,350 | .91640 | 1.48215 | 71,884.28 |
| West Virginia | 24,170 | .79855 | 1,221,119 | 1.33250 | 14,417 | 1.16402 | 1.09836 | 53,270.46 |
| Wisconsin | 56,066 | 1.85237 | 2,333,860 | 2.54674 | 43,854 | 3.54076 | 2.64662 | 128,361.07 |
| Wyoming | 97,914 | 3.23499 | 145,965 | .15928 | 4,844 | .39110 | 1.26179 | 61,196.82 |
| Total | 3,026,719 | 100.00000 | 91,641,197 | 100.00000 | 1,238,548 | 100.00000 | 100.00000 | $4,850,000.00 |

UNITED STATES DEPARTMENT OF AGRICULTURE, OFFICE OF THE SECRETARY—CIRCULAR NO 62.

# The Use of Asphaltic Oils for the Surface Treatment of Gravel and Macadam Roads in Caddo Parish, Louisiana

By J. T. Bullen, Senior Highway Engineer, Office of Public Roads and Rural Engineering

CADDO Parish commenced the construction of an extensive system of hard-surfaced roads about May, 1912, and up to the beginning of this year had completed about ninety miles. Most of these roads have been surfaced with pit-run gravel containing from fifty to seventy-five per cent. of pebbles, with the balance of aggregate composed of varying proportions of sand and clay. About six miles of road was surfaced with broken stone from the Winnfield quarries, and several miles were surfaced with a combination of Winnfield stone and pit-run gravel.

It was early apparent that the surfaced roads would become disagreeably dusty, for they attracted all the automobiles and developed into speedways.

It is natural for vehicles, and especially speeding automobiles, to prefer the center of the road unless they are forced to turn aside by other vehicles. It is also natural under such conditions for both gravel and broken stone to speedily wear into two wheel tracks or depressions. Particularly does this seem to be the case with the clay-gravel surface composed of clay, sand and rounded, worn pebbles, for it pushes out of place and wears down as well.

In that section of the country, where roads are subjected to long periods of dry, hot weather, followed by torrential rains, the economic maintenance of the hard surface is quite a problem. Hoping to solve this problem, we began in August, 1913, to apply heavy asphaltic oil to the gravel and macadam surfaces. I cannot say that this has proved an unqualified success, neither do I wish to be understood as saying that it is a failure. It is my purpose to give some of the details of this work, also the results and my personal conclusions.

Under our first contract we treated about ten miles of gravel and macadam roads with approximately one-third of a gallon of oil per square yard. All of this mileage was completed in from six to twelve months, and was pretty thoroughly consolidated and smoothed out by traffic in addition to the original rolling.

The hard surfaced part of the road, fifteen feet in width, was swept very thoroughly with a regular street sweeper of the rotary type, which generally removed from one-eighth to three-eighths of an inch of fine pebbles, sand, and grit, and deposited it in windrows on the shoulders of the road. Hand brooms of a type used on city streets were also used to finish cleaning any part of the surface that was not thoroughly cleaned by the rotary sweeper. The contract called for the oil to be distributed over this cleaned surface at a temperature of not less than 200 to 225 degrees Fahrenheit, and then immediately covered with the sweepings just referred to. The oil used was obtained from California and contained from eighty-five to eighty-nine per cent. asphalt.

The Finley distributor which was used for distributing the oil further cleans the road by air pressure simultaneously with the application of the hot oil. The theory is that the blower on the distributor dislodges the fine dust from the road surface and then the oil covers the spot before the fine dust settles. Only one-half of the road was treated at the time, the other half being left open for traffic, but notwithstanding the fact that eighteen or twenty men followed closely behind the distributor, covering the oil with the sweepings, the oil was picked up from the surface in some places by passing vehicles before the men could cover it.

Because one or more of the distributor nozzles sometimes became clogged, several stretches of surface required additional treatment a few weeks later, but in thirty to sixty days' time traffic had produced an almost perfect surface, resembling a bitulithic street. The first work was completed in August and in spite of a sixteen-inch rainfall in September, the surface remained hard and smooth, continuing so all during the winter of 1913 and through the spring and summer of 1914. At the end of twelve months, with the exception of a very few breaks or spots, it was still in fine condition and an automobile traveling fifty miles an hour over it would raise scarcely any dust.

In about fifteen months broken places in the surface began to show to a considerable extent, and at each break a chuck hole was formed, until, to make a long story short, the general surface in eighteen months was very rough indeed, and not to be compared with the untreated roads in the same parish. The same thing had occurred that occurs on a sheet asphalt street when once it begins to wear in holes.

The people of Caddo Parish began to clamor for untreated roads more vigorously than they had clamored for oiled roads, and with perhaps few exceptions, they have come to the conclusion that oiling gravel roads is a failure.

But is it? Let us go a little further into this matter.

When we began this work, the only asphaltic oil available had to be procured in California and the freight was as much as the oil. The application of this material under contract had cost us six cents per square yard, or $644 per mile, and the contractor, who lost money on the work, raised the price to nine cents per square yard, or nearly $1,000 per mile. At the end of twelve or fifteen months it was apparent that a thin resurfacing coat was necessary if we were to maintain the bituminous coating in good shape, but we could not see any economy in renewing it at such an expense, so we let most of it run its course, only patching it where there were the worst holes. This was discouraging, as, of course, the surfacing should have lasted for some time for it to prove economical. At the end of two years there were stretches one or two hundred yards, or even a quarter of a mile long still in fine surface, and generally speaking, after two years three-fourths of the oil was still adhering, though the surface was much spotted and broken and exceedingly rough. Had we been able twelve months after the first application to get oil and distribute it at the present prices for oil, I think I could tell you quite a different story.

In 1913, the California oil cost us about eight cents per gallon f. o. b. cars at Shreveport, Louisiana. To-day we can get the Mexican asphaltic oil from Baton Rouge, Louisiana, at about four and one-half cents per gallon. We applied last fall a light renewal coat to some two miles of the first oiled surface and to a short strip of entirely new work at a cost of about two and eight-tenths cents per square yard, or about $280 per mile.

One thing that we have learned positively is that you must not begin oiling roads with a heavy asphaltic oil unless you can and will afford to apply a renewing coat of about one-fourth of a gallon per square yard per year; and you must remember in figuring to include the cost of a covering coat for this renewal, for there will be no sweepings to apply. The cost of the sand and hauling same for the renewal coat applied last fall in Caddo Parish was $219. Had there been sufficient sweepings, the cost would have been reduced to approximately $200 per mile for this renewal.

It is the generally prevailing opinion that pea gravel or small stone chips make the best covering to take up the excess oil and to protect the oiled surface until it has taken its set—and perhaps a small uniform pea gravel is best—but in our last work we could not get pea gravel as it was neither available nor cheap enough, hence a fairly coarse river sand was used as a substitute. I think as a general proposition pea gravel is the better for the reason that at each renewal of the oil surface you are actually adding about one-half inch of gravel to the road, which in itself would equal nearly a year's wear.

On the other hand we have noticed that when the oiled surface begins to disintegrate, many of the worst places were those containing the most gravel in the sweepings. Where there was less gravel and more fine material, the surface apparently was in better condition. There is certainly room for much investigation along this line, though the preponderance of evidence is in favor of pea gravel or clean stone chips.

We have also found that it is practically useless to apply the heavy oil to the road surface unless the road is thoroughly consolidated and the surface so bound that the rotary sweeper will not dislodge any but the fine particles of gravel, clay, and sand. The oil simply will not adhere to the road unless it is clean enough for the oil to get a grip on the pebbles or the stone.

A priming coat of somewhat lighter oil—sixty to seventy-five per cent. asphalt—is sometimes applied on the theory that it will penetrate the gravel more readily and that, when it has set up and the next coat of heavier oil is applied, the heavy oil spreads much more readily on the first oil and adheres to it

better than it would to the gravel. I approve of this method but, of course, it adds somewhat to the cost. If you can successfully apply the heavier material to begin with, you accomplish the same result in appearance, and probably in lasting qualities, and thereby save the expense of applying the priming coat.

Even when the road surface is well bound and in good shape for applying oil, it will be found that an occasional pick-up will occur, due to a damp spot on the surface, a skip of the nozzles, etc., but these occasional spots are easily touched up with hand pouring pots. Even when depressions or settlements occur in the gravelled surface, it is easy to build up the hole by applying hot oil to the spot and covering the same with pea gravel or stone chips. Even when they are several inches deep, holes treated in this manner hold in good shape.

In addition to the pick-ups that occur, another noticeable feature of roads treated with heavy asphaltic oils is the series of transverse waves or rolls which apparently grow more distinguishable as time elapses. I believe these waves are known by some highway engineers as "harmonic waves," but those who have noticed the same waves on sheet asphalt streets will agree with me that there is nothing harmonic about them to the fellow riding at a swift gate in a car with a short wheel base. There are various explanations offered for these waves, none of which are satisfactory to my mind, but of one thing you may be sure; that is, that they will generally occur and, after several successive years of treatment, there is a possibility that the blanket surface will require removal and that a new start be made.

From the tenor of this article so far, I suppose my readers will feel that the general opinion prevailed in Caddo Parish that the oiling of roads is a failure, and I wish to repeat that I do not recommend it to others as an unqualified success, but I do want to call attention to some of the advantages of properly oiling country roads.

It certainly makes a surface that is as dustless as is sheet asphalt or bitulthic, nor is the abatement of the dust nuisance the least advantage of the oiled surface, for it is a well-known fact that dust is a prolific source of disease, and is, therefore, dangerous as well as disagreeable. It is certainly much more resilient than the gravel or the macadam surface, is restful to animals and for this reason must effect quite a saving to the owners of horses and mules. It certainly reduces the wear on horse and mule shoes, probably to the extent of thirty per cent. It is a great deal less wearing on automobile tires, as it does not have the abrading action of stone or gravel, and there is little or no loose stone or grit to work up into worn or cut places on the tires. It most assuredly keeps the gravel or stone in place, and even torrential rains cannot wash the gravel away. Again, there is little or no wear to the gravel since the oil protects it from the wheels and shoes.

Generally around a town of considerable size, travel and the elements will wear a clay-gravel road down at the rate of nearly an inch a year, and an inch of gravel over a sixteen-foot width amounts to about two hundred and sixty cubic yards per mile. In Caddo Parish the gravel in place generally costs about two dollars per cubic yard, so if the oil will keep down this wear there is an approximate saving of $400 to $500 per mile per year. Now, these figures as to actual wear of a gravel road are approximate, because much depends on the character of the gravel or stone, and on the amount of traffic. But under traffic leading into a town of 35,000 or 40,000 people it generally becomes necessary to do some resurfacing of a gravel road after a period of five or six years unless more than eight inches of loose gravel was applied when the road was constructed.

When these matters are properly considered, I think we should hesitate a long time before saying that oiling roads is a failure, and I am watching very carefully some few miles of our Caddo roads and mean to determine much more fully in the next twelve months what method of oiling we can afford which will not only aid in keeping down expenses, but will avoid the harmonic waves that have been heretofore mentioned. It is clear that the character of the oil as well as the method of application will have much to do with the result. In Caddo Parish I believe we had as good road oil as could be obtained and, generally speaking, it was well applied. So we will not fool ourselves by saying we didn't have the right oil. We simply could not, because of the high cost, see our way clear to renew the oil surface when it became necessary. But with Mexican asphaltic oil, which is nearly or quite as good as the California oil, at our very doors, we can afford to make no further trials of oil.

In Caddo we now have our own distributor, holding 1,000 gallons, and it has an attachment whereby we can not only keep the oil hot enroute to the work, but can raise the temperature to 300 or 400 degrees Fahrenheit.

It is no child's play to get a carload of heavy oil unloaded and distributed properly on the road. One man who saw us unloading a car of oil into our distributor remarked: "Gee, if if it takes all that trouble I'd leave the oil off." This reminds me of the drug clerk in an Arkansas town who who a one-gallus customer come in one day and ask for five cents worth of asafoetida. The clerk poured out the asafoetida in a paper bag and pushed it across the counter. The customer drawled out: "Charge it." "What's your name?" said the clerk. "Honeysuckle," replied the customer. "Take it," said the clerk. "I wouldn't write asafoetida and Honeysuckle for five cents."

But we can't take a position like that—we must keep on trying to solve these road problems.

* * *

When the highway engineer has any reason to belive that disputes or misunderstandings are likely to occur on work he should immediately get all information possible and take the matter up with both sides and dispose of the same before any additional difficulties arise. Usually matters can be settled if taken in time, while delay and procrastination will make adjustments harder to arrive at. Another thing which engineers should bear in mind is that they are acting as arbitrator or judge on the work and should have consideration for the contractors as well as the county's rights and interests.—*Minnesota State Highway Journal.*

* * *

Engineers and inspectors on road construction should see to it that all contracts that cannot be finished be left in as good condition as possible to go through the winter. Don't tear up more than can be finished in good time for laying off this fall.


*These SPECIFICATIONS should be on your desk*

FOR main traveled roads brick is the least expensive of all types.

For residential city streets brick is the most satisfactory for every reason upon which choice is made.

*"Pave with Brick"*
is becoming the slogan of the public.

Specifications for monolithic construction either the
GREEN CONCRETE FOUNDATION TYPE
(Laying the brick direct upon the green mortar)
or
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(Laying the brick on dry mixture of sand and cement

*Sent to engineers, contractors and others interested upon request.*

NATIONAL PAVING BRICK MFRS. ASSOCIATION
WILL P. BLAIR, Secretary.

ENGINEERS BUILDING CLEVELAND

Write for Yours To-day



# Better Roads and Streets

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for the
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Subscription Agents Wanted Everywhere. Good Commissions


The Kentucky Good Roads Association will hold its annual convention at Lexington, Kentucky, on September 5, 1916.

* * *

J. C. Watts, Deputy City Engineer, of Troy New York, has resigned to accept another position with the city of Troy, and F. X. Bode has been appointed his successor. The changes took effect in August.

* * *

The front cover of this issue shows one of the Garford Motor Truck Company's, Lima, Ohio, five-ton chassis, equipped with an automatic dump body of four cubic yards capacity, working on road construction near Yuma, Arizona.

* * *

During the sprinkling season of 1915 in St. Paul, Minnesota, a total of 254,248,000 gallons of water were distributed over the streets. This amount was equivalent to a rainfall of nine inches over the entire area sprinkled. The entire downtown section of the city is sprinkled regularly every day or two days, and some of the principal residence streets once, twice, and three times a week. The city uses a large amount of modern equipment in this work.

* * *

Melbert W. Taber, formerly manager of construction and maintenance of the Packard Motor Car Company, Detroit, has been appointed manager of the Detroit office of the Asbestos Protected Metal Company, Pittsburgh, Pennsylvania, manufacturers of the well-known "Pittsburgh" Paving Joint. Mr. Taber has his office in the Penobscot Building.

* * *

In an effort to secure the best and most economical construction of brick pavements the National Paving Brick Manufacturers' Association is arranging for a study and conference to be held on October 5 and 6 with headquarters at the Deming Hotel, Terre Haute, Indiana. A demonstration showing every step in the laying of brick upon green concrete will be given in the vicinity of Paris, Illinois, a short distance from Terre Haute, during this conference.

The association is working on specifications for monolithic and other methods of construction of brick pavements and expect to have them ready for distribution prior to this demonstration.

A general invitation is extended to all engineers and others interested in road building including the good roads committees of automobile associations and chambers of commerce.

* * *

An example of the co-operation and assistance that is being given the Pennsylvania State Highway Department is evidenced by a practical offer that was made to the Department in August. The Maintenance Division of the Department, needing 750 tons of cinders for some work under way, ordered this quantity at the market price of seven cents a ton on the cars from the New Jersey Zinc Company of Pennsylvania, with a plant at Palmerton, Carbon County. The supply agent of the company returned the requisition with a letter asking that the requisition be reissued, inasmuch as his company would be glad to furnish the cinders free to the Maintenance Division. The letter further stated that the company is deeply interested in the improvement of the roads of the State, and that they would be glad to co-operate in road improvement by donating the material for such a cause. The offer was accepted.

* * *

The American Tar Products Company, Chicago, Illinois, has just completed and is sending out a very complete set of specifications that should be in the files of every paving engineer. These specifications cover the full line of Tar-mac products, including Tar-mac, Tar-mac A for treating macadam roads, Tar-mac-filled macadam, Tar-mac T for old macadam roads, and Tar-mac mixed macadam.

* * *

Mayor-elect Louis F. Dodd, of Montclair, New Jersey, has appointed E. M. Harrison director in charge of all street and public improvements. J. C. Barclay is director in charge of public parks, of which there are several with many finely constructed drives under the new administration. Montclair is doing considerable paving and repair work this summer.

* * *

T. M. Ripley, Division Engineer of the New York State Commission of Highways, is recognized as one of the best construction and maintenance engineers of that department. Mr. Ripley has, for several years, been closely watching roads of all types and under all conditions, not only in his own division, but all over New York and adjoining States. While talking on maintenance a short time ago, he included the following in the statement that he made: "It has now been clearly recognized that maintenance must start as soon as the road is opened to traffic, and that definite surface treatment must be given to a macadam road, whether waterbound or bituminous, not later than two years from the date of its completion if the road is to be kept in good condition. Further, the construction forces should never be divorced from the maintenance forces by politics, as so often is the actual case."

* * *

The Russell Grader Manufacturing Company, Minneapolis, Minnesota, has made a donation of a large amount of road machinery and equipment for construction and maintenance to the Jefferson Highway Association to be used in the construction and maintenance of the Jefferson Highway. One of the most interesting pieces of equipment is a new machine which this well-known and enterprising concern is manufacturing, and which constructs a waterproof dirt base for either macadam or oiled earth roads. By a special device fastened to the wheels of the tractor, the earth subgrade is driven down into a compact mass which is then oiled with the cheapest kind of oil. Macadam may then be built on the base in the usual manner, or earth brought up on this base from the sides of the road, thus forming a crowned wearing surface, which should then be thoroughly rolled and compacted and then covered with a heavy asphaltum oil. Roads thus constructed are said to be giving excellent service, and are smooth and dustless.

* * *

Motor vehicles in the United States have increased fifty-fold in the past ten years. Statistics just made public by the Office of Public Roads and Rural Engineering, based on State registration of motor vehicles, show that while there were only 48,000 motor vehicles registered in 1906, there were 2,445,664 registered in 1915. In view of the well-known heavy production of motor-car factories during the present year, it is probable that there are nearly 3,000,000 motor vehicles in service in the United States at the present time. In 1905, little had been done in the systematic registration and licensing of motor vehicles, and the total revenue collected by the various States amounted to only $62,500. In 1915, the State revenues from motor vehicle licenses, permits to chauffeurs, dealers, etc., amounted to more than $18,245,000. Of this total revenue, fully ninety per cent. was applied to road work, and a little over seventy per cent. was expended under the control of the State highway departments. The annual registration of motor vehicles is required in nearly all of the States. In South Caro-




*Arthur Street, Manistee, Mich., before and after the use of "Tarvia-X" mixed macadam.*

# What Manistee did with Tarvia

MANISTEE, Mich., is a "Tarvia town"; that is to say, it has settled down to a regular policy of using Tarvia for the maintenance of its macadam roads.

It has learned, as other towns have learned, that the cheapest way to maintain macadam under modern conditions is to bond the stone with Tarvia.

As a result of this policy extending over nine years, Manistee has many miles of beautiful, smooth pavements.

Notice from this record of sales how the tarviated areas have been extended year by year.

| | |
|---|---|
| In 1907 | 2,500 gallons |
| 1908 | 4,800 gallons |
| 1909 | 3,000 gallons |
| 1910 | 14,000 gallons |
| 1911 | 21,000 gallons |
| 1912 | 18,000 gallons |
| 1913 | 9,000 gallons |
| 1914 | 34,000 gallons |
| 1915 | 32,000 gallons |

Manistee makes use of all three kinds of Tarvia. It has used "Tarvia-B" for surface work and dust suppression, "Tarvia-A" for resurfacing operations, and "Tarvia-X" for road building.

Hundreds of other towns throughout the country have found Tarvia the most satisfactory and economical answer to their road problems.

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This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by anyone interested.

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lina, Texas, and the District of Columbia, however, a car once registered is registered for all time. In Mississippi, one registration by the State is sufficient, but an annual county license is also required. In Minnesota, motor vehicles are registered for three-year periods. The proportion of motor cars to population varies widely. Iowa has one car for every sixteen persons while Alabama has only one for every two hundred. The licensing fees in many States are still very low. In only fifteen States is the average gross return from motor car registration over ten dollars, and many large States receive an average of less than five dollars per car. Vermont's average return from motor car license is $18.10.

* * *

## The Federal Aid Road Law

According to the provisions of the Federal Aid Road Law not to exceed ten per cent. of the total estimated cost of the work can be expended for engineering, inspection, and unforeseen contingencies.

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Read Section 6 of the Federal Aid Road Law and you will find that the one-half paid by the Government shall not be in excess of $10,000 per mile, exclusive of the cost of bridges of more than twenty feet span. It looks to us that there was an intention on the part of Congress to not co-operate in the construction of public roads which will cost both the State and Government more than $20,000 per mile.

---

The first general plans of Federal Aid Road bills were attempts to get the Government tangled up in a "Pork Barrel" scheme and make a fishing pond out of the barrel with all congressmen and senators dropping their hooks into the barrel, but the Federal Aid Road Law passed July 11, 1916, eliminated that feature of the proposed bills and now even before a congressman or a senator can get a square look into the appropriation he must satisfy both his State Highway Department and the Secretary of Agriculture that the road he proposes is one of much travel and of interest to some people outside of his own district.

---

Under our Federal Aid Road Law we feel that the little congressman who has been scheming to build his little road where it will never be traveled by anybody and miles and miles away from a main traveled road will save his time by sticking a pin in his little bubble and forgetting it, for what the people are now demanding are roads that commence somewhere and go somewhere.

---

Don't forget that none of the Federal aid road money can be used for maintenance and repair, for Section 7 of the Federal Aid Road Law reads as follows: "To maintain the roads constructed under the provisions of this act shall be the duty of the States, or their several subdivisions, according to the laws of the several States." And don't forget that in the same section we find the following very plain language: "If at any time the Secretary of Agriculture shall find that any road in any State, constructed under the provisions of this act, is not properly maintained, he shall give notice of such fact to the Highway Department of such State." And don't forget that immediately following that provision we find that the law reads as follows: *"And if within four months from the receipt of said notice, said road has not been put in proper condition of maintenance, then the Secretary of Agriculture shall thereafter refuse to approve any project for road construction in said State, or the several subdivisions thereof, as the fact may be, whose duty it is to maintain said road, until it has been put in a condition of proper maintenance."*

A lot of people throughout the United States thought that the Congress of the United States would be fool enough to appropriate millions of dollars and permit those millions of dollars to be strewn all over the United States in patching and repairing a lot of unimportant roads which had never been properly constructed. This is the real "stinger" in the entire bill and safeguards the expenditure of Federal Aid Road money.

---

In almost every State there will be such an intense scramble in the application of the State's appropriation that the little "pork barrel" advocate who is contending for some unimportant trail in his congressional district will be buried in the mud and lost sight of when the big fellows get through pushing their claims for some main market, interstate or national highway in which the people of the country are really interested.

---

National Highways? Of course we are going to have them. Not first by name but by the co-operative plan of Federal aid as provided for in the law which cannot result in anything else but National Highways in fact and open for travel. It will be many years before this can be realized but even the most radical Federal aid opponent will admit it is a "starter."

---

The United States Secretary of Agriculture hinted in his address before the recent conference at Washington that we needed real road builders and not experts to carry out the provisions of the Federal Aid Road Law, and in this remark he was referring to the large number of engineers who are to be employed by the Office of Public Roads and Rural Engineering with the approval of the Secretary of Agriculture. We feel assured that the Director of the Office of Public Roads and Rural Engineering will proceed with great care in recommending engineers for employment, and that the staff of engineers to be employed by the Director, Logan Waller Page, will be the best who can be induced by the positions offered and the salaries which can be paid to enter this work.

---

Federal Aid roads are here and the amounts appropriated will be enormously increased year after year, but it is not the same old kind of Federal aid that county commissioners and lesser road authorities anticipated would come, and although the editor of this publication has probably made more "rantankerous" Federal aid speeches than any other one man, during the past ten years, he approves of the present law and will give his every effort to co-operate in the administration of the law. He has always been a booster and never a knocker, but in order to get Congress to do anything at all it was necessary for a lot of us "cranks" to push the most radical imaginary schemes that could be thought of in order to get Congress to realize that something really had to be done. The result was that a very carefully thought-out and sane law, such as was possible to pass at this time, was agreed upon and enacted into a law. Now let us all get at it and make the law more popular year after year.

* * *

Until recent years, several of the more exclusive and respectable cities in the United States were without an underground system of sewers. They were furnished with open sewers, or tidal drains, or cess pools, all of which were much approved by the scientific authorities of the period, but none of which contributed to the preservation of the public health. In the European cities about three hundred years ago, persons who claimed to be better than the rest insisted on the right to walk close to the walls of buildings in passing along streets. That was a queer thing for them to do, as seen through the spectacles of the present age, but it was a wholly natural thing in view of the fact that the center of the streets was then lower than the sides and served as a drain or open sewer, just such as obtained in New Orleans only a few years ago, for the refuse of the adjoining houses. This central drain was called the "kennel," so that when the arrogant swashbuckler ordered the humble citizen to get himself away into his kennel. he did not mean to consign him to the dog house, but to the squalor of the middle of the road. In France, this central drain was called *coulouere,* which meant a channel, or gutter, or gallery, and which has come to mean in later times in the English speech of the road-builders, the culvert, "an arched or flat covered drain of brick work, pipes, or masonry, carried under a road, railroad, etc., for the passage of water." Without the word, the road-builders would not know how to describe their work, and without the culvert it would not be possible to build good roads.

If it be poorly built, it will certainly become the source of danger and great expense. Here is a case in point: Some years ago, on the best road from Springfield to Pittsfield, Mas-



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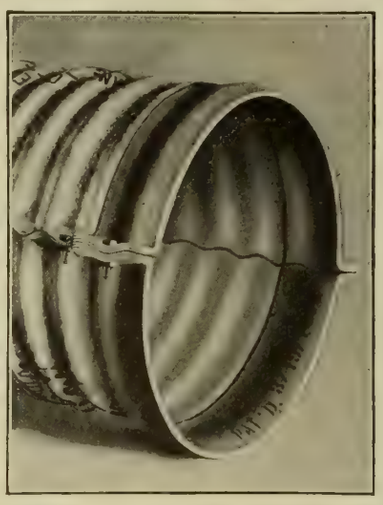
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"The Atlantic Highway Digest" *is an interesting periodical, dealing with highways. It will be mailed free upon request.*

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sachusetts, there was a section several miles long which was crossed by culverts built of rough stone without cement, the slabs forming the tops of the culverts being supported by the side walls. These culverts were all small, probably not more than eighteen inches wide, and their tops were covered with only a few inches of earth and gravel. One year, the warm weather of spring was very late and the rainfall was heavy. When frost came out of the road, the culverts were disturbed, their joints were opened, and the earth and gravel were washed into the culverts, the mass being increased with every rain until finally the culverts were almost wholly choked, with the result that the water delivered to the culverts flooded the side ditches, leaked through the stonework into the foundation of the roadway, and so softened it that the culverts were thrown out of position and made useless for the purpose of their construction. The practical effect of bad culvert construction was observed by thousands of witnesses on Decoration Day of that year. The heavy rainfall just before the celebration converted this stretch of road into an ocean of mud with occasional pools of water so that one could not tell exactly the condition of the road at any point. There was, on this day, heavy automobile travel from Springfield to Pittsfield. The driver of a car taken in the evening to the largest garage in Pittsfield was congratulated on delivering his machine intact, because it was only the third making the trip that day that had not come in with broken spring, sprung axle, or other quite serious injury caused by a wheel dropping into a culvert through an opening in the top.

It may be said that such a record of a day's troubles caused by defective culverts is unusual, and it is, but it is exactly what may be expected to happen under the same conditions anywhere at any time. No culvert that is improperly built is safe or economical. On the contrary, it is a waste of money to spend it on such work unless the work is well done on an approved plan under competent direction. There must be calculation as to the volume of water the culverts are to carry off in rainy season and flood time, not in dry weather, and as to the durability of the material used in their construction. There can be no skimping on culverts or bridges or drainage without waste. It is better to have these three things permanent and adequate than to have an expensive form of road surfacing, if the choice must be made. The man who built his house on shifting sand instead of solid rock has been regarded for centuries as the prince of fools.

* * *

The Clydesdale Brick & Clay Company, of Pittsburgh, Pennsylvania, with a new plant at Elwood, Pennsylvania, has become a licensee of the Dunn Wire-Cut Lug Brick Company, of Conneaut, Ohio. H. J. Orth is president of the Clydesdale Company and W. W. Cunningham vice president and general manager. The Clydesdale plant at Elwood will have a daily capacity of 100,000 paving brick. It is the intention of the company to double the plant's capacity in the near future.

* * *

Many Northwestern mixers of different sizes are being used on a wide variety of jobs and the Canadian government likes this type of machine. One recent shipment consisted of Model 610 mixer having a capacity of twelve cubic feet, weighing 6,000 pounds, which was ordered to go forward by express—an indication of how anxious the Canadian authorities were to get the machine at work on permanent improvements for their largest concentration camp. This mixer is "somewhere in Canada." The censor prefers that we do not make further mention of the facts. All this, however, is suggestive of the way the Northwestern has made good with our friends across the border.

These machines are made by the Northwestern Steel and Iron Works of Eau Claire, Wisconsin. They report a surprisingly heavy business in concrete mixers, even for a "boom" year.

* * *

## Road Improvement and Its Benefits

By A. W. Williams, President of the Michigan-Detroit-Chicago Roadway Association

From the time of the settlement of this country until within the past decade, the life of the farmer has been one of splendid isolation. Not only has he ilved a considerable distance from neighbors as a rule, but the nature of his work, and that of his wife as well, has been such that he has

been afforded but little human companionship. In this respect the life of the farmer has developed a steadiness of nerve and depth of character possessed by no other line of work, business or profession. Those who till our soil are, in reality, the very backbone of the country. They are not easily swept off their feet. They lend but little support to the agitator, whether he be labor leader or political demagogue. Among them, the vast majority are God-fearing, honest, and hard working citizens. More prominent men in the business and political worlds have come from the farm than from any other vocation.

But the farmer's life has not been altogether satisfactory. While the isolation that has been his part developed many good qualities, it has also had its serious drawbacks. Many phases of character can only be brought out by direct contact with other human beings.

The rural free delivery of mail, the telephone and modern improvements now possible to be installed in houses in the country, do not fully equalize conditions between country and city life. During several months out of each year the opportunity for personal touch and intercommunication is largely absent.

The farms in the United States represent our largest industry. From forty to fifty billions of dollars are employed directly in carrying them on, out of a total national wealth of three times that amount. The gross annual income from the farms is estimated at between nine and ten billions of dollars. This indicates only in a general way the magnitude of this great industry. When we consider the number of people who are employed in it, and the fact that all other persons are absolutely dependent upon it, our appreciation of it becomes even greater.

Now that we have a means that will permit of quick transportation of persons and produce and other things, which is of varying cost so as to suit the needs of nearly every pocketbook, an extended argument in behalf of good roads would hardly seem necessary. Sometimes, however, the most obvious things will not be accepted by the majority of people until they are driven home by argument time and again.

If we were to attempt to devise some method by which to assist in enlarging the mental outlook of our citizenship, how would we best go about it? Would we add to the wealth of the country? That might be of little avail, for some of the most narrow people in the world have large means. Great wealth does not signify much so far as breadth of character is concerned, unless it is possessed by an individual who has a close grasp upon the thoughts and aspirations of the people at large. An easy and inviting means of going about and mingling with the people of our own country or State, either on business or on pleasure, will do more for the average individual than almost any other thing that can be suggested.

Good roads will do more for the rural communities of Michigan than we at present realize. There is no other device which modern life can suggest which will reach out into the farthermost sections of the townships and counties and put all of the population in touch with the central life of the vari-




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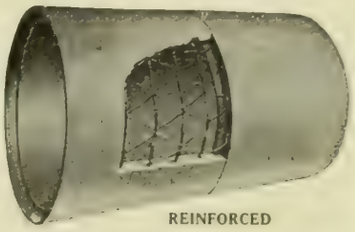
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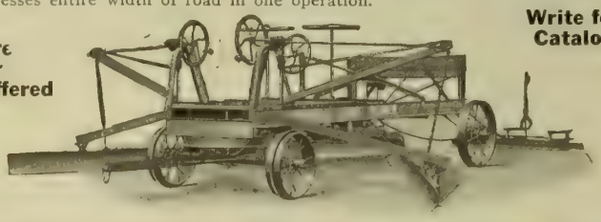
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LESTER KIRSCHBRAUN, Ch. E., Director
Consulting and Testing Engineers
Pavements and Paving Materials
160 N. FIFTH AVE., CHICAGO
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Consulting Highway Engineer
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JAMES H. MAC DONALD
Consulting Road and Pavement Expert
Chamber of Commerce Bldg., NEW HAVEN, CONN.
State Highway Commissioner of Connecticut nearly eighteen years.
Advice given on all phases of road building and street paving.
Consultations on specifications, materials and methods. Specialty of recommending efficient and economical equipment and plant. Accurate estimates for contractors.

ous communities of the State as will good roads. When I speak of good roads, I mean not makeshift good roads, but roads that are scientifically designed and built, and then maintained to carry the traffic which they will be called upon to bear.

Those who have watched those matters in the cities well know that putting a permanent pavement upon any street will immediately cause a bettering of the living conditions upon that street. The old houses will be repaired and will be better kept, and flower beds will appear to adorn the landscape. If the principally traveled country roads were to be equally well treated, that is, made into permanent highways with concrete or some other form of pavement, there is no question but that the same kind of a change in the appearance of things would be quickly noted.

What the people in the rural communities of this country need to-day more than anything else is to have living conditions upon the farm made more attractive so as to compensate for some of the hard work and drudgery.

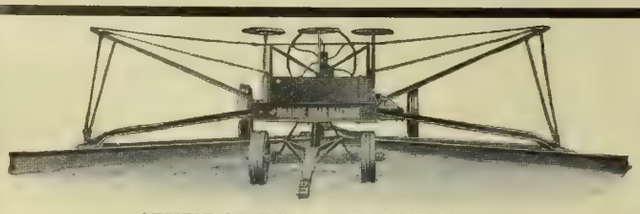
Many rural communities are showng, at each Federal census, a falling off in population. Only those rural communities are growing that are contiguous to cities and are getting an overflow benefit from the commercial growth of such cities.

Paved roads connecting all larger cities and important towns will bring about an intensive farming along the line of such highways, which will mean smaller places but better kept ones, greater rural population, shorter distances to schools and churches, and the development of community life at various points throughout the entire length of such highways.

Extend these highways throughout the State of Michigan, and old communities will take on a new aspect, and new ones will spring into life and prominence. Country life will then have an opportunity of coming into its own; it will, within a very short time, be regarded as it is by many even now, as the most desirable kind of life.

Good roads will make a real business man of the farmer. Many of them are good business men now, as will be found out if one attempts to make a deal with them; but those who have developed in this way have done so in spite of the handicaps that their life has borne. We look upon the manufacturer, for instance, as being the personification of efficiency in organization and management, and in the production and marketing of his products. What could the ablest manufacturers do, however, if they were called upon to manage a business where, perhaps for one hundred days out of each year, it would be utterly impossible for them to get any of their goods to market, or needed supplies to their plants, or where they, themselves, would not be able to come and go as is now the case with all manufacturers who are located upon lines of railroads?

The United States Government thinks nothing of spending $400,000,000 for a Panama Canal, and other great projects have received Federal aid in an aggregate amount beyond comprehension. It is not practical, in view of all the help that has been thus extended to various public purposes, that an adequate amount should be spent during the next decade or two



SEVEN SIZES FRONT VIEW

JUMBO DOUBLE BAR
ROAD MACHINE
SCRAPES 30 FEET WIDE IN ONE OPERATION
BUILDS 12 TO 20 MILES OF ROAD PER DAY
N. S. MONROE & SONS ESTABLISHED 1894 ARTHUR, ILLINOIS

APOLLO-KEYSTONE Galvanized Sheets
Made from KEYSTONE COPPER STEEL—Unequaled
FOR ROADWAY CULVERTS
as well as for Roofing, Siding, Flumes, Tanks, and all forms of exposed sheet metal work. Demand APOLLO-KEYSTONE for your Roadway Culverts. Look for the stencil—it insures greatest durability and resistance to rust. Accept no substitute. Write for our free booklet showing actual service tests.

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AMERICAN SHEET AND TIN PLATE COMPANY, - - - General Offices: Frick Bldg., Pittsburgh, Pa.

TELL 'EM YOU SAW IT HERE.

*Largest Manufacturers of Commercial Motor Vehicles in America*



# White Good Roads Truck

## *Saves Forrest County $2,800 per Mile*

ACCORDING to Mr. C. Russell, supervisor of Beat No. 3, Hattiesburg, Miss., the White Good Roads Truck owned by Forrest County, Miss., is saving the county $2800 per mile in the cost of road building.

Before installation of the White equipment the county paid $3000 per mile for building a certain stretch of gravel-surfaced road. The White Good Roads Truck has since built a sand-clay stretch of the same road, immediately adjoining, at cost of $200 per mile. Its broad, smooth wheels pack and roll the sand-clay mixture giving practically as firm and hard a surface as the gravel.

On the Sunrise-McArdle Road, the White Truck built 12 miles of sand-gravel road, about one-fifth of which was sodded on the shoulders, at a total cost of $1500. For this work the County used one Good Roads Truck, four men and one adjustable grader. This equipment made it possible to grade three miles of road a day at a total cost of $20 or $6.67 per mile.

The White Good Roads Truck has paid for itself in such a short time that the Forrest County officials have decided that they can not afford to do road work without White equipment and have placed their order for a second Good Roads Truck.

# THE WHITE COMPANY

CLEVELAND

*Awarded the ONLY GRAND PRIZE for Motor Trucks at the Panama-Pacific International Exposition, San Francisco*

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*The Widest Possible Range of Uses,*

*The Easiest to Operate,*

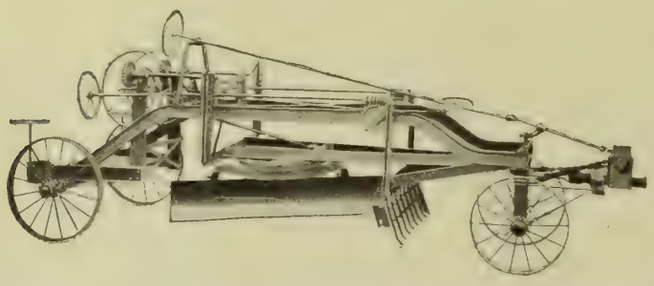
*Longer Service with Lower Upkeep Expense,*

*Lowest First Cost— Quality Considered,*

*Grader and Scarifier in One Machine,*

*Roller Bearing Wheels*

THESE ARE A FEW FEATURES OF THE "PANAMA" GIANT WITH SCARIFIER



This machine is the leader of a most highly perfected line of road machinery, including various sizes and types, one of which is adapted for every requirement.

The "Panama Line" also includes a complete assortment of drags, scrapers, culvert pipe, etc., so that road contractors and officials can choose anything required from this complete line.

But best of all, they can have absolute assurance of obtaining the greatest possible value in doing so, as each and every number has been developed by continuous experimenting to a point near to perfection.

But you will want to judge for yourself, so send for the Panama Catalog and

**Investigate the "Panama" Line.**

MAIL OR USE FOR MEMORANDUM

The F. B. Zieg Mfg. Co. Fredericktown, Ohio.

Gentlemen:-

Send your catalog as offered in Better Roads and Streets.

Name.....

Address.....



THE F. B. ZIEG MFG. COMPANY

*Fredericktown, Ohio*

TELL 'EM YOU SAW IT HERE.


along lines which will do so much to reach and serve the people of the country at large, not only to their economic advantage, but also for their betterment in many others ways?

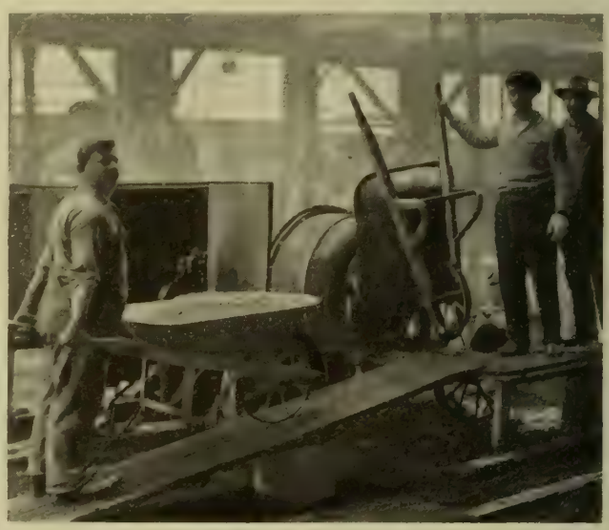
We need more good road advocates from among the farmers themselves. If they could only be aroused to vigorously take hold of this matter, they could get good roads leading into every neighborhood and section of every county of Michigan or any other State in the next few years. I beseech them to study this matter and to investigate it, and to determine for themselves if it is not true that improved roads will mean increased valuations, the result of which will be reflected in enlarged opportunities. They will find that the boys and girls will be glad to stay on the farm because of the more attractive life. There will be fewer retired farmers in the towns and less tenancy in the country. There will be a better citizenship than we now possess either in town or country, and our proudest and only true aristocracy will be one of character and worth, passing its title down from father to sons among those who live upon and till the soil.

* * *

## New Concrete Mixer Accelerates Road Work

The new concrete mixer which arrived by the steamer Enterprise on her last trip is already being utilized by the road department having been requisitioned by Road Overseer Lyman for the concreting of Front Street.

This mixer has already demonstrated that it is so great an improvement over the old equipment that the progress of the work of laying concrete on Front Street will be considerably accelerated—so much so in fact, that unless more funds are provided for the work, the laborers will find themselves living a life of ease for the better portion of the ensuing month.



The mixer is a chain belt mixer and was obtained by the county from the A. L. Young Machinery Company, of San Francisco, through the Honolulu Iron Works. It has a capacity for mixing fourteen cubic feet of concrete and distributing the mixture just where it is required, thus saving a great deal of unnecessary labor. At the present time the mixer is not being operated to its full capacity due to the fact that the workmen are as yet too inexperienced to take full advantages of the facilities offered, but it is anticipated that within the course of the next couple of weeks the county will be laying from 175 to 225 lineal feet of concrete road daily, the road being twenty feet wide.—*Extract from Hilo Tribune, Hilo, Hawaii, of May* 28, 1916.

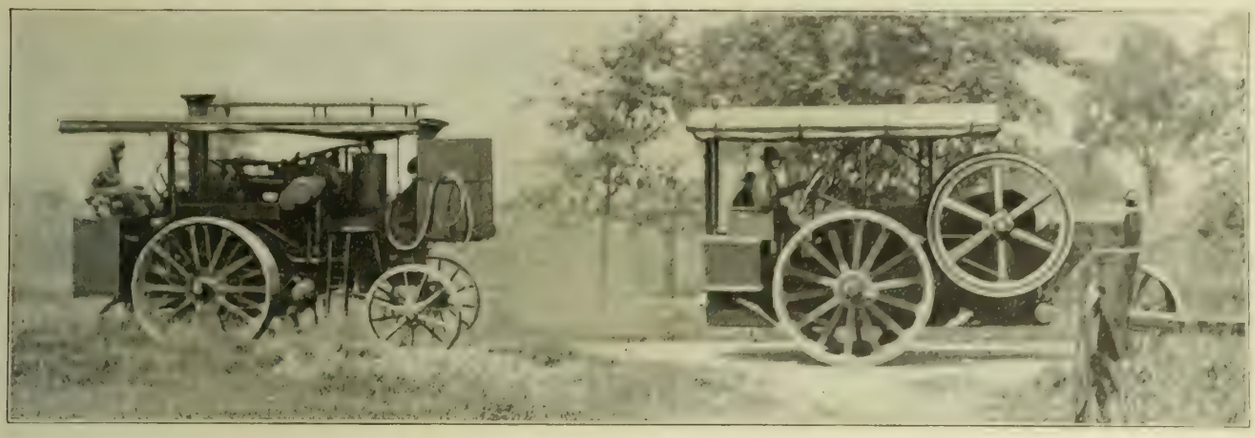
* * *

## Road Construction in Europe

Roadbuilders will be interested in the accompanying illustration which is a reproduction of a photograph taken near Leotzen in East Prussia.

But for the garb of the workmen this might be a picture made anywhere in the United States as the familiar Koppel cars, products of the Orenstein-Arthur Koppel Company, general offices and plant at Koppel, Pennsylvania, which are used extensively in German road building, are in evidence in the picture.

# An Expensive Scarifier



THE above illustration is reproduced from a photograph recently sent us from the State of Ohio and furnishes such a practical proof of our contention that Austin Motor Road Rollers are more adaptable for all kinds of road work than steam driven machines that we would like our customers and those interested in road-making generally to take note.

The steam roller in this case was furnished with an attached scarifier across its rear end for tearing up old roads, the teeth or tynes being held into the road by a cylinder supplied with steam from the boiler to exert pressure and hold the teeth into the work. On the roller failing to furnish enough power, both to hold down the teeth and also to pull them, it was decided to help it out by using an Austin Motor Roller which had been in service six or seven years. It was found that the Austin Roller exerted so much power that it was no longer necessary for the steam engine to be used at all. In other words, the Austin Roller furnished the power both to propel the steam engine along the road and operated the scarifier for them as well.

## THE MORAL

Of the story is, that with a satisfactory scarifier of the Austin type, used along with an Austin Roller, all the work could be accomplished without the investment in the steam roller at all and its accompanying expensive operation. The accompanying letter from the County Engineer in charge, confirms the point we are making.

Delaware, Ohio, June 26, 1916.

The Agents
Austin-Western Road Mchy. Co.,
Columbus, Ohio

Gentlemen:--

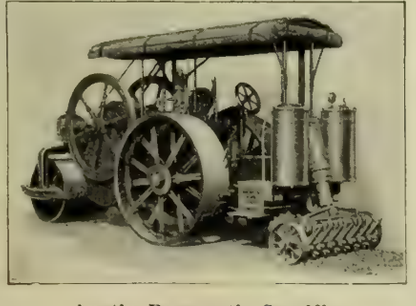
This is to certify that I, George Cross, Engineer for Delaware County, have been operating a single cylinder Austin Motor Roller for about four years, in scarifying, grading, rolling and general road work.

On account of increased road work this Spring, the County put a double cylinder X Roller and scarifier also on the work, using the Austin Motor Roller simply to roll the roads and the X Roller to scarify them. At the present time we are working on the Columbus and Delaware pike in Orange Township along the C. D. & M. traction line, making it necessary for us to double head the X Roller in scarifying the roads, the X Roller not having sufficient steam to hold the scarifier in the ground, the steam pressure ranging on the X Roller from 155 to 180 lbs.

We have worked about four or five miles of this road this way using the Austin Motor Roller to aid in pulling the X Roller behind the Austin with a chain, part of the time without steam in the X Roller and occasionally with steam in it.

(Signed) George W. Cross,
Sunbury, Ohio.

For full particulars regarding Austin Motor Rollers, Austin Pneumatic Attached Scarifiers and other important machines in our complete road-making line, apply to



Austin Pneumatic Scarifier

## The Austin-Western Road Machinery Co.

Chicago, Illinois

BRANCH OFFICES:

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Atlanta Dallas
San Francisco Los Angeles St. Paul



Austin Separate Scarifier



*Plymouth Locomotive at Work in Shale Pit of Alliance Clay Products Co.*

# "Plymouth Locomotive Costs Half of Steam"

—Says WILCOX

Manager J. B. Wilcox, of the Alliance Clay Products Co., Alliance, Ohio, says he has replaced his six-ton steam dinky with a Plymouth Locomotive and more than doubled production at half the cost. Mr. Wilcox found that—

## The Plymouth

GASOLINE INDUSTRIAL LOCOMOTIVE

**Has These Six Points of Superiority:**

1—It is Cheapest to Buy. 2—It is Cheapest to Install. 3—It is Cheapest to Operate. 4—It is Cheapest to Maintain. 5—It has Greater Draw-Bar Pull. 6—It has Greater Traction Pull.

**Here is How Mr. Wilcox Proves These Points:**

"We bought a Three-Ton Plymouth Gasoline Locomotive 18 months ago to supplement the work of our six and one-half ton steam dinky in hauling between our shale bank and plant. The Plymouth costs much less in every way and does much more work than the steamer. Now we have discarded the steam dinky and have traded the three-ton Plymouth for a Six Ton Plymouth.

"We found the little Plymouth gave more service than the steamer—there were no stops for repairing and fueling: no overtime for cleaning and mending. An unskilled man has replaced the engineer and mechanic who had charge of the steamer. Fuel and oil bills are about one-third of the steamer.

**THIS BOOK TELLS** We have a book that tells the complete story of the Alliance concern and of many other owners of Plymouths, in addition to full description, cost, data and other valuable information about haulage problems similar to your own. Your copy of the Book is ready—send for it today.

**THE J. D. FATE CO., 209 Riggs Ave., Plymouth, O.**

KOPPEL

## CARS, DINKIES and PORTABLE TRACK

***FOR SALE or RENT***



*KOPPEL ENGINEERING SERVICE HELPED THIS OUTFIT TO PAY FOR ITSELF IN ONE SEASON.*

Koppel engineers suggested the outfit partly pictured here. The benefit of their advice and the efficiency of Koppel Haulage Equipment was proved out by the outfit paying for itself the first season.

*Write for similar advice and sale or rental terms.*

**Plant: Koppel, Pa.**

ORENSTEIN-ARTHUR KOPPEL CO.

*Branches Throughout the World*

*SALES OFFICES:*
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TELL 'EM YOU SAW IT HERE.

It is a common practice among the warring European nations to put prisoners of war at some useful work. This serves the double purpose of breaking the deadly monotony of prison



camp life and of furnishing the prisoners with pocket money as, in accordance with the rules of war, the prisoners are paid a specified sum of money for any work they may do.

* * *

The following is a good likeness and a brief sketch of the activities of Mr. Rodman Wiley, recently appointed commissioner department of public roads, of Kentucky, since leaving college in 1906.

Graduated from the Civil Engineering Department, Kentucky State College, in 1906.

For four months was draftsman on hydro-electric proposition with Hugh L. Cooper, Consulting Engineer.

For twenty-five months assistant engineer on construction by Viele, Blackwell & Buck, Consulting Engineers, New York, being engaged on the construction of a hydro-electric power plant known as the Feather River Project for the Great Western Power Company.

For twenty-two months chief engineer and superintendent of construction for the Livermore Water & Power Comern Power Company.



**RODMAN WILEY**
**Commissioner, Department of Public Roads of Kentucky**

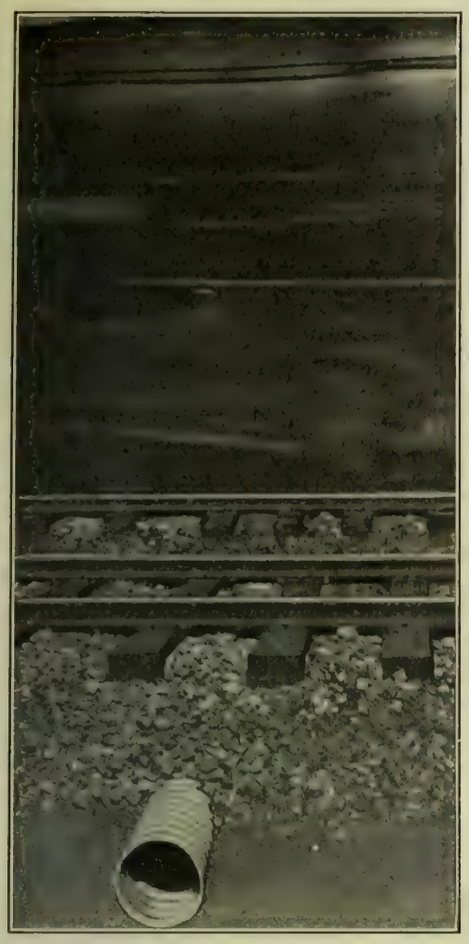
For seven months engineer in charge of the Overflow Basin surveys for the Hydraulic Engineering Company of Main, Keokuk, Iowa.

For ten months, for experience, worked in rigging gang on the construction of the Keokuk project for the Mississippi River Power Company, Keokuk, Iowa.

For three months assistant superintendent tunnel construction for the Mexican Light & Power Company, Berestain, Mexico.

For eleven months tunnel superintendent on the same project but under the supervision of Jacobs & Davies, Inc., New York.

For two years and eight months bridge engineer for the Department of Public Roads, Frankfort, Kentucky.



# For Highway and Railroad Drainage

## Reliability, Long Service and Real Economy are embodied in

# "Armco" Iron Culverts

They are easily transported and installed. Their corrugated form and overlapping joints confer ample strength together with a *flexibility* which makes them to a great extent immune from damage by frosts, floods or settling foundations.

Their material, by virtue of its remarkable purity and evenness, ensures a lifetime of service.

**For full information as to Rust-Resisting "Armco" (American Ingot) Iron Culverts, Flumes, Sheets, Roofing and Formed Products, write to**

AMERICAN ARMCO INGOT IRON

Resists Rust

## Armco Iron Culvert Mfrs. Association

Cincinnati, Ohio

# Over 30% of the Orders for Thew Shovels are Repeat Orders Repeat Orders Indicate Satisfied Owners



WONDERFUL claims will sell almost any machine.

The number of repeat orders received measure the real value of the machine itself.

The rated capacity of The Thew Shovel, like the policy of The Thew Company, is conservative.

Many Thew Owners are securing outputs more than double the rated capacity of the Shovel.

**239 Thew Owners** have been so well pleased with their shovels that they **have given repeat orders. During the past 20 years, 411 repeat orders have been received out of a total of 1300 orders received.**

Other much advertised machines come and go, but verily The Thew goes on forever.

**During the First Four Months of 1916, Forty-Six Repeat Orders Were Received From Thew Owners.**

The latest design Thews are more popular even than the old machines. The same efficient fundamental principles are still employed, but the machines have been strengthened wherever weaknesses have developed and at the suggestion of over 1300 Thew Owners for nearly 25 years. Any up-to-date Thew may be depended upon to deliver maximum outputs with a minimum cost of maintenance, day after day, month after month, and year after year.

Operated by steam, gasoline or electric power.

**Are you familiar with the latest design THEWS?**

**If not, write for Circular 26-B and List of Thew Owners near you. It will pay you.**

## THE THEW AUTOMATIC SHOVEL COMPANY, LORAIN, OHIO

# Bitoslag

An Improved Asphaltic Concrete Pavement made by special process.

Especially adaptable for communities where slag abounds.

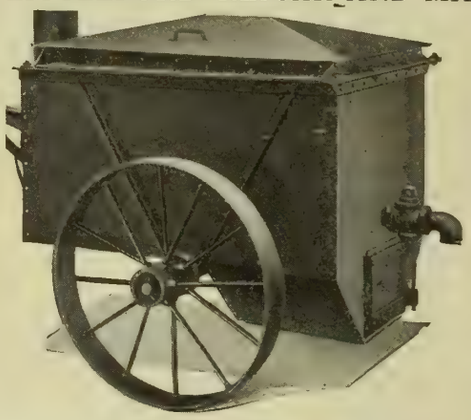
For detailed information as to License Agreements, Specifications, Etc., write

**The Bitoslag Paving Company**

**90 West Street, New York, N. Y.**



**LITTLEFORD REPAIR AND MAINTENANCE HEATER No. 69**



**(Proof of the Heater is in the Heating)**

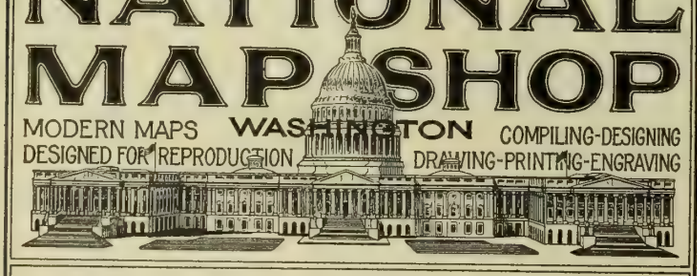
This heater has been designed especially for the purpose of heating small quantities of tar and asphalt in connection with repair and maintenance work on streets and roads. Its compact design and durable construction without doubt make it the most efficient on the market.

**LITTLEFORD BROS.**

**400 East Pearl Street**
**CINCINNATI, OHIO**



**NATIONAL MAP SHOP**




**Attractive maps talk! If you want YOUR map, plat or diagram to get an AUDIENCE, you can't afford to overlook this point. Tell us what you want and let us give estimates and samples. ROAD MAPS FOR BLUE PRINTS OR LINE CUTS A SPECIALTY**

TELL 'EM YOU SAW IT HERE.


Thirty-three years of age and an associate member of the American Society of Engineers.

Appointed Commissioner of Public Roads of Kentucky by Governor A. O. Stanley June 28, 1916.

* * *

## Paying for Good Highway Bridges

No matter how good the surface of a road may be, if the bridges are weak and the culverts poor, the highway is far from satisfactory. The annual record of bridge failures under threshing machines and other heavy loads makes a long list, and the cost of repairing the annual damage to poor culverts is a large sum. In progressive communities, therefore, strong steel and concrete bridges and well built culverts are being constructed before expensive road surfacing is done. This work is often paid for out of the annual tax levy for road and bridge construction, and absorbs such a large part of the funds that too little money is left for grading and surfacing. Good bridges and culverts are permanent structures, and the Deputy Minister of Highways of Ontario, Hon. W. A. McLean, has advised the taxpayers of that province to pay for them by a bond issue where the total expenditure for the purpose is large. In such a case he suggests compiling a complete list of the bridges and culverts needed, preparing plans and estimates for their construction, and then financing the work so that its cost will be equitably distributed over a period of years rather than be concentrated on the taxpayers of a few years. Where there are few of these structures and none is expensive, the policy of paying for them out of the annual tax levy cannot be criticized, in his opinion, for it does not interfere appreciably with satisfactory progress in grading, drainage, surfacing, and maintenance.

* * *

## Local Road Clubs

Only a few persons get what they wish without working for it. Good roads cannot be obtained by merely wishing for them. It is necessary to work for them, and to work continually and forcefully. This is just as true of good dirt roads as of the most expensive types. Furthermore, one or two men in a community can accomplish very little, except to persuade others to help actively in the campaign for improvements. Roads are community affairs, and good roads are only obtained and maintained by community energy, expended continuously. It is not enough for a man to say he is interested in good roads; he must prove his faith by his works. Hundreds of good road clubs have been organized, but few have lived long or accomplished much because they did not work continuously along well-laid plans. Yet there is hardly a community where a good roads club cannot become a strong influence in improving the local highways and byways. The main roads receive the attention of the State and county officials, but the much greater mileage of roads which are not parts of through routes must always be of local concern only. The improvement of through routes by the active, united effort of numerous persons interested in touring is one of the most noticeable results of a large part of the present methods of road propaganda. The same kind of work in a community will bring about equally good results in the betterment of local roads. It is the system of local roads which means most to a large portion of the rural taxpayers, for it is over the local roads that they go to market, their children go to school, and they take part in the social life of their neighborhood. The local club can accomplish a great deal of good for these roads, as has probably been shown most noticeably by the results of the work of the Three Hundred and Sixty-Five Day Road Club at Carthage, Missouri.

* * *

## National Park to Park Highway Association

In the Canyon Hotel, Yellowstone National Park, on July 24, 1916, delegates from Wyoming, Montana, Oregon, Colorado, Idaho, and California met for the purpose of perfecting an organization to join all the National Parks in the Rocky Mountain region and along the Pacific coast with one good highway, to be built by the co-operation of counties, States, and Federal government.

Mr. Gus Holms, chairman of the organization, Cody, Wyoming, in opening the meeting, in part said: "The suggestion




*Illustrating Our Sign in Use on the Cluster Light Standard in Front of City Hall, of Columbus, Ohio*

OUR GUARANTEE

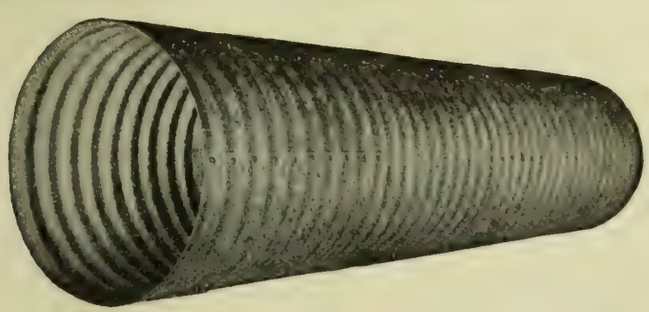
A sign, the legibility of which, cannot be destroyed by the most severe bending or striking test. A sign that is guaranteed against the cracking or breaking or deterioration from rust for a term of thirty years, on which the lettering never needs renewing. A sign on which the surface coating of the lettering and the surface finish of the plate may be renewed without removing the sign from the standard. A sign which can be refinished and made as good as new at any time at a cost not exceeding 20 per cent. of the original purchase price.

*Send for Our Booklet and Testimonials*

**The Indestructible Sign Co.**

61½ Prescott Avenue COLUMBUS, OHIO

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# WHEELING CULVERTS

## For These Reasons:

1. They are full gauge, full size.
2. Each length of pipe is a perfect culvert.
3. The material is doubly durable—Portsmouth Iron Sheets and Portsmouth Iron Rivets—thoroughly galvanized with clean pure spelter.
4. The price of Wheeling Culverts is based on their cost of manufacture plus one small and reasonable profit only.
5. Because they have not disappointed a single purchaser and cannot otherwise than satisfy **you.**

**WHEELING CORRUGATING COMPANY, WHEELING, W. VA.**

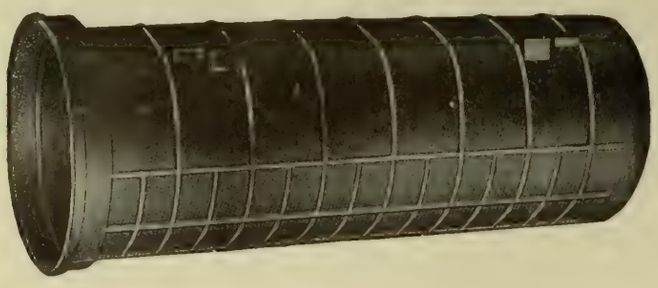
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# SAVE TIME—SAVE MONEY

USE THE

## Burch Expansion Cast Iron Culvert Pipe



8 to 48 inches diameter, 3 and 4 ft. lengths.
Half sections which lock with lugs.

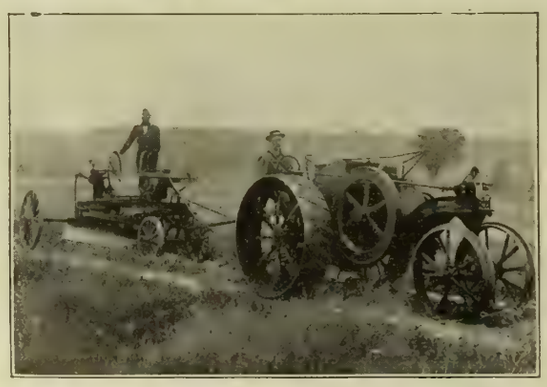
Provides for expansion and contraction. Easy to handle and lay in ditch. Requires less excavation. Strong and durable. Send for Catalog "F" giving full description of complete line.

## THE BURCH PLOW WORKS CO.

CRESTLINE, OHIO



# Mogul and Titan Tractors Operate on Kerosene and Other Low-Priced Fuels



Years ago the makers of Mogul and Titan tractors realized that if there was to be cheap power for building roads, it must come from the lower priced fuels—not from gasoline. Accordingly, the keenest inventive minds and the best skill obtainable were put to the task of designing tractors that would use kerosene as well as or better than other tractors operate on gasoline and at the same time do the most reliable work. The Mogul and Titan kerosene tractors are the successful result as experienced road commissioners and contractors know.

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for this highway was first proposed by Assistant of the Interior, Hon. Stephen T. Mather at a conference in Yellowstone Park last year. Following the idea advanced by him the Yellowstone Highway Association, which takes the responsibility of the first link in the great highway, took up the giving of the suggestion as much publicity as possible and this meeting is a culmination of the plans which the officers of that association have made.

"I have had made in my office a map which will explain very clearly the plan as outlined and while this map is not intended to establish a definite route it will show the section of the United States in which it is located and the nine States through which it passes. In some instances I have shown two feasible routes and where these exist the States through which they pass may take up the question and decide which shall be declared the official highway.

"You will note that every trans-continental highway merges into Park to Park highway and all become feeders to this the most scenic road in the world. The route tours the Yellowstone with its strange phenomena, goes through Montana to Glacier Park with its rich foliage, beautiful flowers and immense glaciers, thence on to the west coast with various points of interest enroute, down to Yosemite with its ancient trees, some of them thirty feet in diameter, on to Los Angeles and into Arizona to take in the grand canyon of the Colorado. The mesa Verda, ancient home of the cliff dwellers, a new national park, is a point of interest and from there Colorado is traversed taking in the road to the top of Pike's Peak, the Garden of the Gods, Rocky Mountain National and Estes Park.

"This highway of 3,500 to 4,000 miles cannot be built at once, but by organization and concentration of effort upon it within five years it may become a standard width road. By working together we will secure Federal aid and State aid upon it until we have a comfortable road that will be travelled over with pleasure and satisfaction."

On suggestion of Mr. Holms the convention then selected as temporary chairman and secretary, Mr. H. J. Miller, of Livingston, Montana, and L. L. Newton, of Cody, Wyoming.

Colonel Brett, Superintendent of the National Park, welcomed the delegates and closed with the hope that through the efforts of the Park to Park association the Park highways would soon become boulevards.

Addresses of especial interest were made by Hon. Stephen T. Mather, Assistant to the Secretary of the Interior, Major Fries, of the war department, Hon. Huston Thompson, first assistant Attorney General of the United States, George C. Deihl, Chairman of Road Committee, American Automobile Association, and Hon. A. T. Vogelsang, Solicitor of the Department of the Interior.

Report of the Organization Committee that the temporary organization be made the permanent organization was adopted by the convention with the amendment that Gus Holms, Cody, Wyoming, be made president and L. L. Newton, Cody, Wyoming, secretary of the National Park to Park Highway Association.

* * *

Recent news from Washington to the effect that it is conservatively estimated $1,500,000,000 will be expended by the Federal government, State governments, counties, and townships during the next five years on road construction and maintenance, came as particularly interesting and gratifying information to officials of the Garford Motor Truck Company, of Lima, Ohio, who for several years have worked tirelessly to further the good roads movement. The Washington item reports that approximately $25,000,000 are to be spent annually on the highways and byways.

"Out of the Land of Mud" has been the slogan of the Garford Company. It has expended thousands of dollars for literature, promoting road improvement, which has been mailed far and near. Big Garford trucks have also played their part in the spreading of the propaganda and the company now begins to feel that its reward is in sight. In spite of the returns already visible, however, its campaign goes earnestly on and, as far as the Garford organization is concerned, the work of educating the people to the necessity of road construction will not be concluded until every highway in the United States is in fit condition for ordinary traffic.

"Although it is true that many good things in the way of highway improvement have been accomplished during the last few years," said E. A. Williams, Jr., President of the Garford Motor Truck Company, the other day, "it is equally true that road conditions on the whole are deplorable. We have received reports from 2,565 motor car and motor truck dealers throughout the country who claim that the condition of public roads in their territory is from 'bad to fair,' and fair only during dry weather. Isn't that in itself an astounding situation? Isn't it strange that we progressive and enlightened American people should allow the very arteries of our country's transportation and travel system to remain clogged and impassable? It's a wonder that the business of the country has not become sick and died off long before this.

"The reason for this state of affairs is that a large majority of the people have not been educated to know what vast development lies before them in the construction and maintenance of their roads. It is our aim to organize all motor car and motor truck dealers into a gigantic teaching force for road improvement education purposes. The work is well under way and in several localities splendid results have been accomplished.

"We complain of the high cost of living and the farmer complains of the high cost of marketing his product. By our educational plan, we are showing that farmer how he can immediately reduce the cost of marketing his product. The United States Board of Agriculture estimates that the farmers of the United States are annually losing $250,000,000 simply because of their inability to market their produce at certain times of the year. Investigation also shows that in many counties rich in agricultural products, but burdened with bad roads, the annual incoming shipments exceed the outgoing. With improved roads, however, those counties could not only be self supporting, but they could also ship produce to other markets. The farmer, let it be known, is not slow to see the logic in our method for improving these conditions, when it is explained carefully to him, and that is where our educational system is accomplishing good results.

It is indeed pleasing to know that more than a billion dollars are in sight for road maintenance and improvement, but that should not be the signal for good roads enthusiasts to stop their campaigning. There is still much work to be done and, the harder we apply ourselves to the task now, the greater will be the reward and the sooner it will come."

* * *

Celebrating the first year of progress in the construction of the Dixie Highway from Chicago to Miami, Florida, the Hamilton County Dixie Highway Council of Cincinnati will hold a Good Roads Exposition and Convention at Music Hall, Cincinnati, October 20-28, 1916. The exposition will consist of modern materials and equipment for the building of better roads and streets, motor trucks, touring cars, automobile accessories and equipment, semi-rural home comforts, the products and advantages of all important cities on the route of the great Dixie Highway, and an exhibition of Cincinnati's home products. The convention will include good roads lectures and addresses by governors of the various States through which the Highway passes, lectures by heads of highway associations and a Good Roads School for county officials.

The President of the United States and governors of the eight States through which the Dixie Highway passes, together with various senators and congressmen interested in the good roads movement, have been invited to make addresses at this convention. Several tours over the Dixie Highway and highways which are feeders to it, are being arranged. The program of the convention has been so arranged as to arouse interest, both general and sectional.

* * *

## Copy of Agreement between City of Nashville, Tenn., and the Southern Bitulithic Company, Witnesseth:

This agreement entered into July 8, 1916, by and between the city of Nashville, Tennessee, and the Southern Bitulithic Company, Witnesseth:

1. That it is distinctly understood and agreed in the making of this contract the Southern Bitulithic Company reserves all of its rights of action for damages, interest, etc., of every





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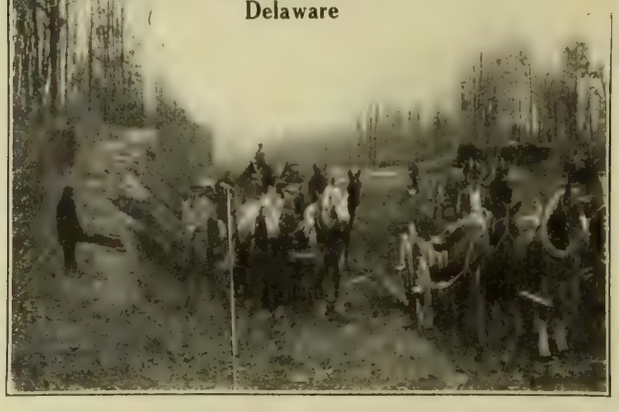
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kind and character and against all persons and the carrying out of this contract and the re-commencement of work shall not be construed as a waiver of any of said rights of action, etc.;

2. That the city of Nashville has this day paid to Southern Bitulithic Company the full amount due for work previously done under contracts—said Southern Bitulithic Company having waived as hereinafter provided its right to interest on said sum;

3. Southern Bitulithic Company has this day signed an order dismissing its case against the city of Nashville now pending in the District Court of the United States for the Middle District of Tennessee and said city agrees to pay the costs thereof;

4. Southern Bitulithic Company shall immediately proceed to perform within a reasonable time all work provided for in its contracts with the city of Nashville and both Southern Bitulithic Company and the city of Nashville shall carry out said contracts in strict accord with their terms and provisions; and said city shall at once, upon request of Southern Bitulithic Company, give notice to pave and assist in every way the expeditious completion of any and all streets covered by said contracts;

5. In case Southern Bitulithic Company is permitted to complete said contracts without interference and the city promptly and faithfully observes and complies with all the terms and provisions thereof and of this agreement, then and in that event, Southern Bitulithic Company agrees and covenants not to sue the city of Nashville for damages because of delay, interest, etc., heretofore incurred.

It is expressly understood that this agreement is not entered into, or intended by the Southern Bitulithic Company as a release of any claims or actions, that it may have against those other than the city of Nashville by reason of the damages resulting from delay, etc., as aforesaid.

And furthermore, it is understood that this instrument is merely a conditional covenant not to sue the city of Nashville as herein provided and is not a release of the Southern Bitulithic Company's claim for damages against any other person.

In testimony whereof the parties have caused this instrument, and a duplicate thereof, to be signed on the day and date above mentioned.

For further information address the Southern Bitulithic Company, Nashville, Tennessee, or Warren Brothers Company, Boston, Massachusetts.

* * *

## Swamp Roads

By George W. Cooley, State Engineer of Minnesota

Road superintendents sometimes fail to provide the elaborate drainage necessary to obtain a proper foundation, because expensive drainage work reduces the funds available for surfacing. This applies particularly to the great mileage of main rural roads on which there is an insistant demand by road users for surfacing, with impatience at any delay made to provide proper foundations.

In undeveloped swamp country, the most permanent work is obtained by building the roadway embankment of material obtained by dredging a ditch on the upstream side of the road, with an auxiliary road ditch on the other side.

The top soil from the ditches is first spread over the roadway and the dredge then excavates enough firm material to provide a substantial foundation when deposited on the top soil. The ditches are dug with practically vertical sides, in order to obtain the largest amount of firm material, usually found at the bottom. The ditches must be of sufficient size to provide the necessary drainage after they have become contracted by the breaking down of the slopes. The low points in the ditch, excavated to secure material, will become filled with sediment after a year or two.

It sometimes appears extravagant to make such large ditches on road work, but in new country lateral drainage is always carried to the road ditches and should be provided in advance. There is not much difference in cost, however, between small ditches dug by hand and a large dredged ditch, on account of the lower cost of machine work per cubic yard.

After drainage is secured, the important work is to eliminate all vegetable or perishable matter and to build up the foundation uniformly. Dragging and planing the subgrade as it is being built will prevent the wavyness of surface which

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develops occasionally after the completion of a road, and it is advisable to specify such work. Surfacing with gravel constitutes the final work on the main rural roads in many parts of the country, and a great deal of money is wasted in not preparing the foundation properly for this surfacing. Until it is compacted, the coat of gravel acts like a sponge, holding water until the foundation becomes so soft that traffic drives some of the gravel into the underlying material. This causes not only a loss of gravel but also an uneven surface.

A hard foundation for gravel can be obtained where the soil is clay by spreading two or three inches of sand or gravel over the clay, mixing them together, and rolling until a smooth surface is obtained. With a sandy subsoil, clay is required to make a firm foundation. Where no clay is available, success has been attained by spreading about four inches of loose straw over the sand, but care must be exercised to prevent the straw from becoming mixed with gravel. Muskeg or pulverized peat has also been used to advantage under like conditions.

* * *

## Earth Roads

By H. G. Shirley, Chief Highway Engineer of Maryland

It will be many years before the earth road will be in the minority, and in places, it will neither be economical nor will the taxable resources justify the construction of a higher type.

The earth road has often been maintained by the most ignorant men, in fact, it has not been maintained at all. It has been generally believed that it would take care of itself, requiring no work except, perhaps, the cutting away of bushes and possibly shaping with a road machine in the spring to give it better drainage to the side ditches. I know of no other type that has been so abused or has received the careless and inefficient maintenance to which the earth road has been subjected. There is no type upon which so much money is being wasted as the earth road, primarily through ignorance and neglect.

I have seen instances where a soft place existed in a hollow badly underdrained. Year after year a large amount of stone was hauled to this place and dumped on it, where it disappeared by the close of spring. Nevertheless this procedure would be steadily adhered to every successive year until the stone finally formed a compact mass. But the moisture in the earth made a mudhole at each end, and the same performance had to be repeated at each end the next year until a large quantity of stone finally displaced the mud. This is expensive road.

Earth roads should be worked in the early spring. If the roadbed is rutted, in bad condition, and flat, without the proper cross-section, it should be plowed from gutter to gutter, shaped with a road machine until it has the proper cross-section, and then kept constantly dragged until it is properly consolidated. After the road has been given this attention, then with a little constant care, it can be kept in good condition until the freezing and thawing are at hand, when it is necessary to dig it up again just as soon as the frost leaves the ground.

In maintaining earth roads we find that after the road has been properly shaped, the ditches opened, and the road given the proper cross-section, a patrolman with a split-log drag can keep from five to eight miles in good condition for at least ten months in the year. The patrolman drags the road after each rain, when the earth is in a moist and damp condition, and thus the road is kept smooth and has the proper cross-section. A description of the method of making and using such a drag can be obtained without charge from the United States Office of Public Roads and Rural Engineering at Washington.

When the road is dry and the surface is in good condition, the patrolman spends his time in opening up the gutters, filling any small washes that may occur in the shoulders, and if there are any spots in the road where the earth is soft and of such a nature that it will not bear the traffic, he digs it out and replaces it with good material. In places where there are wet spots, owing to the lack of proper underdrainage, the patrolman digs them out and fills them with stone or logs, making blind drains. I have found that by first putting down a layer of field stone, next placing three logs so as to form a kind of trough, and then filling in over the logs with stone, an efficient underdrain can be made to eliminate a wet spot.

To maintain a mile of earth road properly will cost from $40 to $100 a year, depending largely upon the character of soil upon which the road is built as well as upon the amount and kind of traffic.

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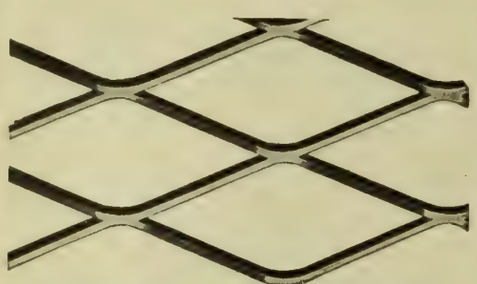
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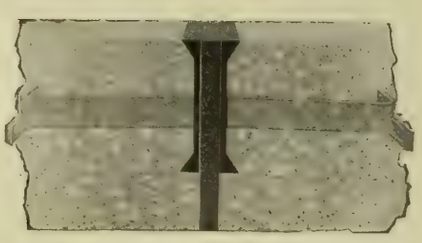
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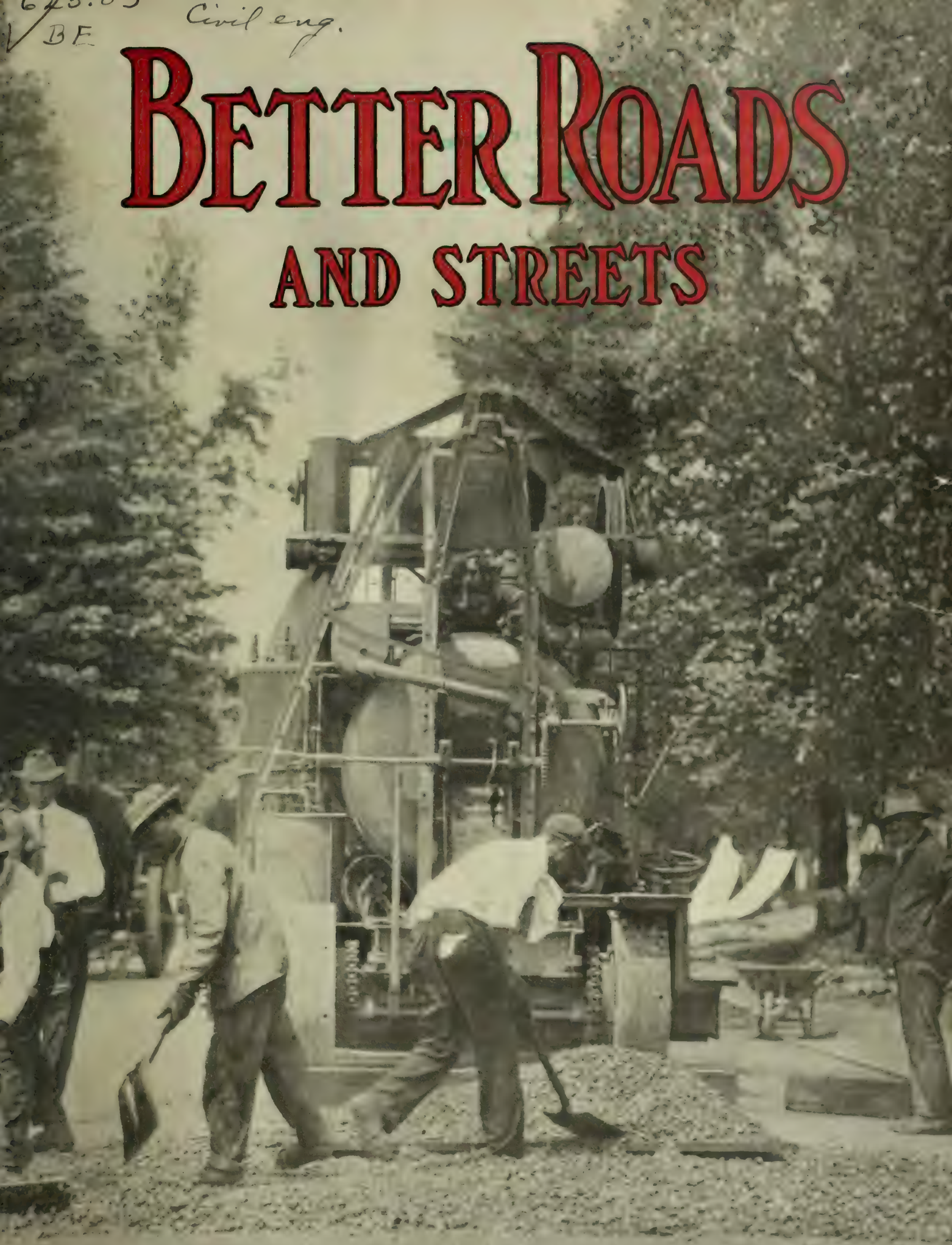
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# Better Roads and Streets

VOL. VI. NO. 10 OCTOBER, 1916 PRICE FIFTEEN CENTS


## Portable Asphalt Plants for Country Roads and City Streets

### Descriptive Article No. 1

By George D. Steele

THE present year has been the greatest in the history of the country for the construction of bituminous pavements, both on city streets and on country roads, that this country has ever known. There has been a large increase in the yardage of sheet asphalt laid in 1916 as compared with any other year; there has been a still greater increase in the yardage of bituminous concrete, penetration macadam, and macadam surface treatment; there is every reason to believe that this increase will be still further increased annually for some years to come. In fact, with the general success that has been given by these bituminous pavements, combined with their comparatively low initial costs, and later maintenance costs, where the work has been properly constructed and the right materials used, it is impossible to see why there should not be a great increase in the yardage of the bituminous pavement. The yardage of concrete pavements has increased rapidly for some years past, and is and will continue to increase in years to come, as the pavement is growing rapidly in popular favor. In most cases, however, the concrete pavement is only used where it should be used—on roads that are called upon to carry the heavier traffic, on city streets and alleys. The same applied to the more expensive types of the bituminous pavement. Sheet asphalt should, with few exceptions, be used only on city streets, while the more expensive types of bituminous pavements, lower in price than the sheet asphalt pavement, should be used for the boulevards and heavy traveled roads. Then the cheaper types of bituminous pavement fit in for a possible total of many hundreds of thousands of miles on roads that need protection merely on the surface and to lay the dust.

There is probably no type of pavement that has received more abuse in its actual construction than has and does the bituminous concrete, the bituminous macadam, penetration macadam, and the bituminous surface treatment job. Much of this abuse is due to the inexperience of the contractor and to the fact that he is undertaking this type of work when he has only equipment suitable for the construction of water-bound macadam, gravel, etc. Some of the abuse is also due to the fact that some contractors have totally inadequate and poorly-constructed plants, many of these being "home made" by those who are as inexperienced as the contractors themselves. The result is that the road constructed soon goes to pieces, becomes full of pot holes and is generally a failure. The bituminous material is very frequently burned in the poorly-designed and poorly-constructed plant. The inexperienced contractor does not understand how to apply it, with the result that part of the road has an excess of bituminous material, while other parts and spots will not even have a quantity sufficient to coat, let alone bind, the stone.

For the above and various other reasons, every care should be taken by the contractor in the selection of his bituminous mixing plant, or in its construction, if he is building it himself, or having it built for him. There are a dozen really good plants on the American market to-day. There are also a dozen that are really worthless. The contractor need not feel that he must pay out a fortune for his plant, as such is not the case. This also applies to the city, town, county, or other unit which proposes doing its own repair work, its own construction work, or a combination of both. If the plant is being purchased complete, great care should be taken that it is a well-designed and constructed one, built by a concern of known good reputation. If the plant is being designed and constructed by the contractor or by the municipal unit, extreme care should be taken in such design and construction. Excellent plants in use to-day, such as the municipal plant at Norfolk, Virginia, have been constructed by the municipality. But in such cases, a competent engineer, familiar with bitumen, should be in charge of the design and construction. In such cases, much valuable aid can be secured from the asphalt companies with whom the contractor or the municipality is doing business, as these companies are always most anxious to have their materials properly used, both as regards the heating of the materials and the mixing with the aggregates.

As has already been stated, there are a large number of concerns engaged in the manufacture of portable, semi-portable, and stationary asphalt plants. Some of these are absolutely reliable, while others, frankly, are not. It is the purpose of the writer, in this series of articles, to describe in detail, the construction and operation of only those plants which are known to be first class in all details, and which can, without hesitation, be purchased by the contractor or municipality for bituminous road and city street construction. These are not being described in any particular order, either of quality, of plant, or price, and the information that will be given is derived both from the manufacturers themselves and the actual users of the plants. Where expression of opinion is made, this is to be construed as the personal opinion of the writer only, and is occasioned by his personal use of several of the plants that will be described, and no recommendation for any particular plant can or will be made. The object is to place before the readers of BETTER ROADS AND STREETS detailed data and information concerning plants of known merit, with the hope of inducing all who will have to purchase asphalt plants for bituminous construction to purchase the best at a moderate price rather than the poorly-constructed and inadequate plant at a lower price. Inasmuch as this series of articles will continue throughout the winter and early spring, those having reliable cost data and information on the operation of portable asphalt plants, whether commercially manufactured or "home made," will confer a favor if they will send such information and photographs to the author, who is Associate Editor of BETTER ROADS AND STREETS.

#### THE WARREN PORTABLE ASPHALT PLANT.

The Warren Portable Asphalt Plant is not a pared down edition of the large stationary plant of this company (The Warren Brothers Company, Boston, Mass.), and was not evolved by the reduction of the size, weight, and working capacity of the various units of the large plant until these units are small enough to mount on wheeled trucks. It is a full-sized plant of its type, and is a radical departure from the older type of paving plants, although it is not in any manner to be considered as an experiment. The plant has been in use for many years by the Warren Brothers Company on contract work of its own, and this continued use has demonstrated that the quality of the product turned out is unequaled, and that it is vastly superior to the mixtures turned out by some of the inferior plants that are on the market to-day.

One of the several important features of this plant is that in mixing asphalt topping, asphalt binder, the so-called open asphalt mixture, and the Topeka specification mixture, no change whatever is necessary in changing from one mixture to another, and all can be mixed with equal facility. In addition to the ability to properly mix any kind of new wearing surface, this plant is also adapted to heating and reworking old sheet asphalt wearing surface for use in making repairs to existing pavements. It has been thoroughly proven through continued use that this plant will do this without injuring the asphaltic cement in the old pavement. Several of these plants have been worked continuously on this kind of work, and have given the best results at a considerable saving in the cost of the resultant mixture, as but little extra asphaltic cement is required to rejuvinate the old pavement if the mixture is properly heated.

The capacity of the Warren Portable Asphalt Plant will, as in all other asphalt plants, vary with the amount of moisture that may be present in the mineral aggregate that is used, and also will, to a greater or less degree, depend upon the skill of the men who are operating the plant and the general conditions under which the plant is operated. Under average and ordinary working conditions, however, the plant will have a capacity of from one hundred to one hundred and fifty square yards of two-inch wearing surface, after compression, per hour when sand containing five per cent. of moisture is used, and in like proportion on other mixtures and moisture contents.

In mentioning the capacity of the Warren Portable Asphalt Plant, it will not be amiss to say a few words on the general subject of the capacities of paving plants. The Warren Brothers Company, since they started the manufacture of commercial paving plants of all types, have always rated the capacities of these various types of plants in terms of what they may be reasonably expected to do, day after day, under average and ordinary working conditions, and not what they might be able to do with special preparation under a test of an hour or two. In other words, the capacities given are for continuous, average runs, day after day, and are not capacities which have been noted when the plants have been pushed hard on a special run of an hour or two. The reason for this is that there may easily be a fifty per cent. difference in actual capacity for plants as rated in these two ways. Yet there are, to the writer's personal knowledge, some plants on the market to-day which are rated under the latter condition, and which have been proven by purchasers to be impossible to operate to the so-called rated capacity under any general, continuous, working conditions.

Warren Portable Asphalt Plants are continually being operated on the basis of an average daily output of one thousand square yards, and frequently more, of full thickness, two-inch wearing surface. The large capacity of this plant, as compared with its actual size and the initial cost, is rapidly doing away with the demand for the older type asphalt plants with a capacity of a thousand to twelve hundred square yards per day. In some cases, contractors have preferred to work two of the portable plants together rather than one of the old-style plants having twice the capacity. This procedure has the advantage that when the larger contract has been finished, the contractor has two plants that he can use to take care of his contracts in different cities at the same time with a much smaller outlay than if the whole investment were in one plant, which, of course, could only attend to one contract at a time. In such a case, the contractor has found that his actual costs for moving the two portable plants from one place to another, are considerably less than they have been in cases where he had the larger, old-style plants to dismantle and ship.

The portable plant is also simple and easily operated, and on account of its great simplicity of construction, fewer expert attendants are required than with the large and generally complicated plant. This results in very large savings when the plant is out on repair work, or when, in intermittent new construction, it is not considered economical to organize the operating force to obtain the full capacity of the plant continuously. On account of this decrease in the fixed overhead expense, the cost of labor in running this portable plant is low, and is proportionate to the output.

Unusual uniformity is obtained in the product from these plants. This is due in a large measure to the size of the batch used. Usually three thousand pounds of mineral aggregate is mixed with the proper amount of asphalt cement for each charge. The natural variation in the screen test of the mineral aggregate as it is taken from the storage piles is thus averaged up much better than when the batches are but one-fifth or one-sixth as large. Each batch, as it is measured out, is kept by itself until it is discharged as a completed mixture into the trucks or wagons, to be hauled to the street where the work is being done. Each stage in the operation of the plant and the passage of the different batches through it is under the independent control of the operator in charge of the plant.

When the plant is used in mixing asphalt topping, the limestone dust is dumped into the receiving hopper of the elevator with the sand, and goes into the dryer with the sand. There it is thoroughly mixed with the sand, and is dried and heated at the same time, so that when the charge is dumped into the mixer, the limestone dust is the same temperature as the sand, which insures a much more uniform distribution of the asphalt cement through the mixture with less liability of the mixture balling than with the type of plants where the cold limestone dust is added to the hot sand in the mixer. The hot sand, being relieved of its duty of drying and warming up the limestone dust filler, does not have to be heated to as high an initial temperature as it did under the older method, and for this reason there is not nearly so much danger of burning the asphalt cement when it is first added to the sand.

### DESCRIPTION OF THE PLANT.

The Warren Portable Asphalt Plant is self-contained, and the entire plant is mounted on a single truck, with the exception of the melting kettles, the latter being, for convenience, mounted independently on a separate truck. The weight of the plant proper, complete for use, is about twenty-nine thousand pounds, and each of the melting kettles weighs approximately forty-eight hundred pounds additional. The tools, tongues, etc., including everything necessary, weigh a trifle over one thousand pounds additional, so that the total shipping weight of the plant complete with two nine-hundred-gallon melting kettles is less than forty thousand pounds, or a minimum car load. The proportions of the plant are such that the complete outfit may easily be loaded on a forty-foot flat car or gondola, leaving ample clearance, and takes the minimum freight rate on all railroads. This is an important item to be considered in the purchase of such a plant, as ease of loading and freight charges can constitute a large and important item to the contractor.

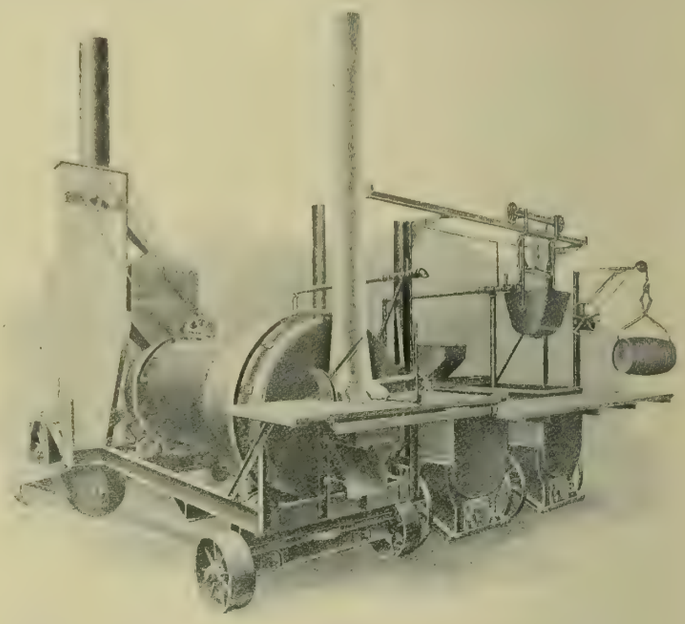


**Figure No. 1 View Showing Operating Platform at the Discharge End of Plant**

Having the power plant mounted on the same truck with the mixing and weighing units of the plant itself is not only a great help in erecting and dismantling the plant, but it also insures true alignment of the machinery at all times, and entirely does away with the expensive and annoying delays which are always present and encountered with the plants which have to depend for power on a boiler and engine mounted on a separate truck. This compactness of the entire outfit is secured without sacrificing economy or efficiency or operation of the plant in any way, and even though the engine and boiler are fifty per cent. larger than the actual power requirements of the plant itself, the weight of the combination is in no way excessive and the outfit can be very easily hauled around from place to place by the steam roller, which is always to be found on the job, or by means of horses.

The portable outfit is equipped by the manufacturers with a wooden tongue for use when horses are used in moving it from place to place, and also with a heavy iron draw bar to be used when the outfit is drawn around by the road roller, a traction engine, or tractor. On ordinary streets and roads, where the grades are slight, four horses are all that are necessary to move the plant about, although where the grades are steep, additional horses will naturally be required. There have

been a number of instances where, on smooth and level streets and roads, the plant has been moved from place to place by two horses.

The over-all height of the machine, over the top of the elevator, when set up, is sixteen and one-half feet, so that under all ordinary circumstances in moving, the elevator need not be taken down on account of interference with overhead structures. All that is necessary in most cases is the lowering of the boiler smoke stack, the stack on the discharge end of the plant, and the removal of the elevator boot, all of which can be done

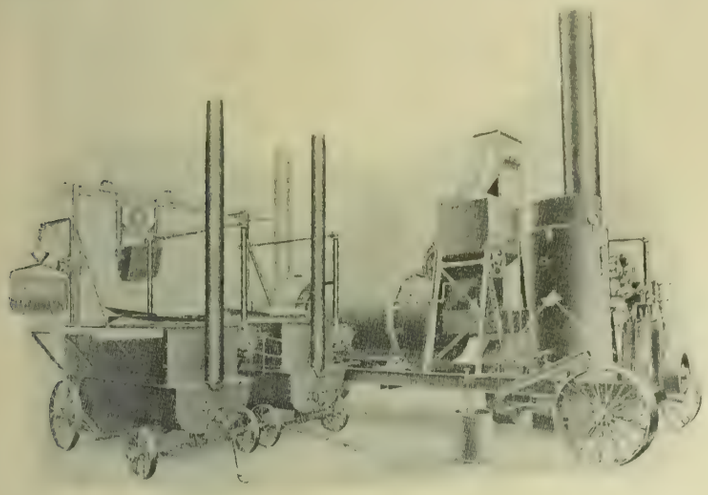


**Figure No. 2. Rear of Portable Melting Kettles, showing method of driving asphalt pumps, and the piping from pumps to the asphalt weighing bucket when pumps are used. A good idea of the accessibility of all working parts of the plant may be obtained from this view.**

in a few minutes. When the overhead clearances are less than will permit the machine to pass under after the foregoing changes are made, the boiler bonnet, elevator casing, and the top of the bin can easily be removed, and this will reduce the total height of the plant to ten feet.

The truck wheels are all heavy and substantial, the front ones being twenty-eight inches in diameter and the rear ones forty-four inches. All wheels are equipped with ten-inch, extra heavy tires.

For controlling the plant on grades, powerful and substantial brakes are provided on the rear wheels. The brakes on each rear wheel are controlled and operated by separate hand wheels, so that in case of accident to one of the brakes, the

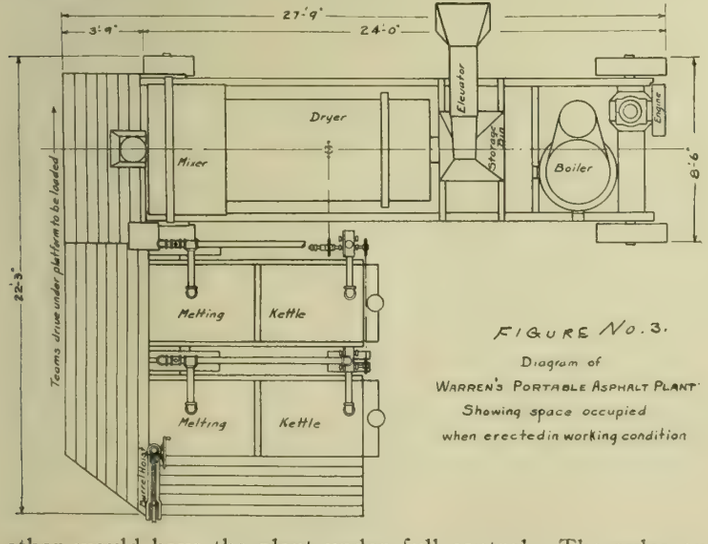



FIGURE No. 3.
Diagram of
WARREN'S PORTABLE ASPHALT PLANT
Showing space occupied
when erected in working condition

other would have the plant under full control. The axles on both ends of the plant are made of extra heavy steel, and the manufacturers pride themselves upon the fact that there has never been a single failure of either a wheel or an axle on any plant that has been turned out. This is considered really remarkable, in view of the fact that some of the plants have necessarily been subjected to extremely rough usage and have seen unusual service in mountainous and rough country where they have been used on construction jobs.

Steam for the plant is generated in a thirty-five horsepower, vertical boiler, which has full-length tubes, and which is built for a working pressure of one hundred and thirty pounds. This boiler in every way meets the requirements and specifications of the American Society of Mechanical Engineers, which have been adopted by a number of States, and it is only a question of a short time until they will be adopted by all leading States, so that boilers of cheaper and inferior construction will be prohibited in most places. The fire door of the boiler is located on the side of the plant, which is most convenient for firing. The boiler is fitted with an offset hood with a removable cover, so that one man can easily scrape the flues without assistance, which is impossible with the ordinary vertical boiler having the stack over the center of the boiler. This results in great economy in fuel, as there is no excuse for the plant being operated at any time with the flues full of soot, as is almost invariably the case where the flues cannot be conveniently and easily cleaned by the night watchman, to whom this duty usually falls.

The engine used in driving the plant is of extra heavy construction. It is of the enclosed type, with a cylinder having a six-inch stroke, the diameter being eight inches. The engine is provided with the splash system of lubrication. The working parts are all readily accessible through conveniently-located hand holes of ample size in the frame. All of these hand holes have removable doors which keep all dust and dirt from the working parts of the engine. The mainshaft of the engine is a solid steel forging supported by two heavy bearings in the engine proper, and one large bearing on the end of the shaft adjacent to the main driving pinion. The engine is equipped with an Erie throttling governor, with an automatic safety cut-off, which stops the engine in case the governor belt should break, and thus prevents the engine from racing.

### OPERATION OF THE PLANT.

Fuel oil is used to furnish heat for drying the mineral aggregate. The working supply of oil is contained in a galvanized iron tank mounted under the fuel oil pumping system, and has a capacity of fifty-five gallons. This tank can be filled either by pumping from the source of supply through the fuel oil pumps, or it can be filled through a funnel that is provided in the top of the tank. The fuel oil is handled by a No. 3 Blake fuel oil pumping system, which is provided with two 3″ x 2″ x 3″ duplex pumps operating independently of each other, one being in reserve while the other is in use, thus affording ample protection against break-down while the plant is in operation.

The exhaust steam from these pumps passes through a heater coil in the oil heater, so that the oil is always delivered to the burner hot, thus insuring high efficiency in the burning of the oil in the combustion chamber. The pumps are connected with a speed regulator which slows down the pumps when the oil pressure reaches the desired point and prevents their racing when the pressure is lowered. Constant oil pressure is maintained in the heater by means of a regulating valve which allows the oil to overflow into the reservoir when the desired pressure is reached.

If desired by the purchaser of the Warren Portable Asphalt Plant, a mechanically-driven pump for the fuel oil supply will be installed instead of the steam pumps. This optional pump is a rotary pump driven by gears direct from the engine shaft. Cut gears are used, which are enclosed in a tight gear case, effectually protecting them from dust and accident. When the rotary type of oil pump is used, a live steam connection is made to the heater coil in the oil tank, instead of the exhaust connection used with the steam pumps.

The oil burner discharges into the fire-brick-lined combustion chamber which enters the receiving end of the drying compartment, and directs the products of combustion along and through the material in such a manner that the hot gases themselves do not come into immediate contact with the outer shell of the drying compartment unless the drier is empty. The combustion takes place entirely within the combustion chamber, and since the hot gases are directed into such immediate contact with the material being dried, the efficiency of the drier is naturally very high, and by the time the hot gases reach the discharge end of the drying compartment, their temperature has been reduced to a point that is only a little above the boiling point, owing to the perfect absorption of the heat by the sand.

The amount of fuel oil required to dry a ton of sand in the drier of the Warren Portable Asphalt Plant is less than is required in even the largest of the older type, continuous driers, and when the continuous driers are cut down to a small size in order to make it possible to mount them on trucks with other units of the paving plants, their efficiency is greatly reduced.

About one-half ton of coal per day is required to fire the boiler plant, and from one hundred and fifty to two hundred gallons of fuel oil daily is required to operate the drier under ordinary conditions. If the sand sent through the drier is particularly dry, this amount of fuel oil will be reduced to between seventy-five and one hundred gallons, but the first-named figures can generally be counted upon under average conditions.

To operate the entire plant to its full capacity, a comparatively small force of men is required. The following distribution of the operating force will be found, after the men are broken in, to give the greatest efficiency:

One foreman.
One engineer.
One lever and mixer man.
Two laborers for filling melting tanks.
Six laborers to handle sand from storage pile to receiving elevator.

The number of laborers required is directly proportional to the output of the plant, so that if it is not desired to realize the full capacity of the plant at any time, the number of laborers can be reduced to correspond to the desired output.

For the class of work performed, the maintenance and repair charges necessary to keep this plant in first-class condition are regarded as particularly low. When proper attention is given to the handling of the plant, the cost or expenditures for repairs will be confined principally to the renewal of the fire brick lining of the combustion chamber. Under continuous operation, day after day, the lining of this chamber will have to be replaced every six to eight weeks.

All of the wearing parts of the plant are made very heavy, and only the best materials are used throughout. The driving pinions and trunnion wheels are of manganese steel, and with ordinary care, will run continuously for a couple of years at least, without any necessity for their renewal and replacement. All parts of the portable plant are built to templates and are interchangeable throughout. Therefore, replacements, made necessary by accident or otherwise, can be had on short notice, as all parts are always carried in stock by the manufacturers, and when the parts are received, the owner of the plant can feel certain that they will fit and that the plant can be placed in operation without any delay. Owing to the fact that all parts are stock parts, they can always be secured at reasonable prices.

The drying and mixing cylinder is carried on heavy turned tires made of high carbon steel. These tires revolve on manganese steel trunnion wheels which are carried on heavy shafts running in bronze lined bearings of heavy and substantial construction. The two bearings for each trunnion are cast in one piece, which insures their perfect alignment and which makes adjustments for wear simple and easy.

The elevator into which the mineral aggregate is fed is enclosed in a substantial, galvanized steel housing and is equipped with a receiving hopper on the boot. This receiving hopper is of sufficient size to permit the wheelbarrow loads of sand to be dumped directly into the elevator which carries the sand up into the receiving bin.

The receiving bin has a storage capacity of thirty-five cubic feet, which is larger than is required for ordinary use. The outlet from the bin into the drying compartment is controlled by a gate operated by a lever on the mixing platform. The gate between the drying compartment and the mixing compartment, as well as the discharge gate from the mixer into the wagons, are also controlled from the mixing platform by the same operator.

At the discharge end of the mixer there is a hood connected with the smokestack, which carries away the steam and the hot gases from the mixer.

The asphalt cement is melted in two nine-hundred-gallon, portable melting kettles which stand on one side of the mixing plant proper, and flush with this part of the plant so as to permit free and easy access for teams along the discharge end of the plant. The trackway carrying the asphalt weighing bucket is supported entirely by the kettles, and has no connection with the plant proper, so that the vibration of the mixing plant and engine has no effect upon the accuracy of the scales. The bucket has a capacity of forty-two gallons, which is sufficient for the largest size batch which the plant will carry. This bucket is suspended from an asphalt scales equipped with a fifteen-inch dial, and is mounted on the standard Warren asphalt bucket carriage, which is so constructed that it permits of free up-and-down movement to the bucket, this being necessary to insure accurate weighing. At the same time, however, it holds it rigid laterally so that the asphalt will not spill when the bucket is being moved. This bucket is discharged through a butterfly valve in the bottom into the receiving funnel which carries the asphalt cement into the center of the mixing compartment. The bucket is pivotally mounted so that it can be turned upside down for draining when it is not in use, and the scales which are used enable the operator to get the exact weight of asphalt cement in each batch without the necessity of calculating the tare each time the bucket is filled.

The asphalt cement may be handled from the melting kettles to the bucket in the ordinary way by means of long-handled asphalt dippers, or by means of rotary asphalt pumps attached to each kettle, as shown in Figure No. 2. When these pumps are used, they are driven from the main driving shaft of the plant and are controlled by means of a friction clutch which can be instantly thrown out of service when the pumps are not needed, or when they are not in use. These pumps are steam jacketed and are piped up to the asphalt bucket, with overflow pipe leading the asphalt cement back into the tanks. There is, therefore, no possibility of overflowing and consequent waste. Another feature of these pumps is that they handle the asphalt cement continuously so that they are a valuable aid in agitating the asphalt cement when it is not being drawn off into the weighing bucket.

The kettles are provided with substantial steel brackets for supporting the working platforms around the front end and side, giving ample working space for the operator, as well as making the operation of charging the kettles an easy one. The outer kettle is equipped with a barrel crane to which is attached a special hand-power differential hoist, by means of which asphalt barrels can be quickly raised from the ground to the charging platform by one man. This is the most efficient and most effective charging arrangement which has yet been devised for portable plant work. A pair of barrel tongs is furnished with the plant, to be used in connection with this hoist, as shown in Figure No. 2. The kettles are provided with covers that are hinged in the middle so that these covers can be thrown back, or they can be entirely removed, if desired, while the plant is in operation. The kettles are mounted on four-wheel trucks, and are of the most substantial construction throughout.

The fire boxes under these kettles are of ample size to furnish all the heat necessary to properly melt the asphalt cement, and they are equipped for burning either coal or wood. The sides are fitted with cast-iron liners to protect the side sheets of the kettle settings from the direct heat of the fire. The rear wheels of the kettles are supported by means of heavy cast-iron spiders, these not being directly supported by the fire boxes of the kettles themselves. This construction insures the wheels always being in line even if through carelessness the sides of the fire boxes should be buckled and damaged.

The tanks of the melting kettles are ten feet long with the bottoms made from a single steel plate so that there are no riveted seams in the center of the tank to give trouble by springing leaks. On account of the large heating surface provided, the kettles are both rapid and efficient heaters. Each of the kettles is equipped with a draw-off cock, by means of which the contents may be drawn off from the bottom of the kettle, if desired. These draw-off pipes are screwed into the heavy castings riveted to the end and bottom sheets, which makes it impossible for the pipes to become detached from the kettle unless they are actually unscrewed or broken off.

It is worthy of mention that with each of the Warren Portable Paving Plants a full set of screw jacks, pump jacks, chains, block and falls, crowbars, etc., for handling the plant on and off the cars, and for use in taking the strain off the plant frame when the plant is in operation, is furnished as part of the equipment. All small tools necessary to erect and dismantle the plant, with the exception of shovels and wheelbarrows, are also fur-

nished. This is important, as will be appreciated by those who have received asphalt plants which came without suitable equipment with which to unload and erect it. In such cases, the feeling that all tools will be received with the plant, and that they can always be shipped accompanying the plant, is worth several times the actual value of the tools themselves.

In operating the plant, the charge of mineral aggregate is measured in its raw state in measuring wheelbarrows of sufficient number to hold a complete batch, the capacity of each of the wheelbarrows in sand or stone having been previously determined by weight. The whole charge is then dumped into the continuous bucket elevator, which carries it up to the storage bin, which has ample capacity, as has already been stated, to receive the entire batch. It is then held in the storage bin until all of the previous batch or charge has been discharged from the drier into the mixer. When the drier has been emptied of its previous charge, the batch in the storage bin is discharged into the drier through the outlet gate in the bottom of the bin, this outlet gate being controlled by the operator on the mixing platform. When the bin is thus emptied, the outlet gate is closed and the next batch, which, in the interim, has been measured into the wheelbarrows, is fed up into the storage bin.

In this way, each batch is measured out separately and is kept together distinct from every other batch during its passage through the plant. At the same time, however, four batches are in the process of manufacture, making the operation practically continuous. One batch is being measured out in the wheelbarrows, another is in the bin ready to be discharged into the drier when empty, a third is in the drier, being dried and heated, while the fourth batch is in the mixer being mixed with the asphalt cement. There is no time lost between operations, one charge advancing after another, so that the laborers filling the wheelbarrows are kept continuously employed.

In the drier the batch distributes itself evenly through the cylinder lengthwise with the aid of the spiral conveyor, which is riveted to the interior of this drum or cylinder, and by reason of the rotation of the drier, the sand is carried up to nearly the top of the drier cylinder and is then cascaded in a continuous fine shower through the hot gases which come from the combustion chamber which has already been described. By reason of the very intimate contact of every grain of sand with the hot gases passing through the drier, practically all of the heat in the hot gases is absorbed by the sand, and the spent gases pass from the discharge end of the drier through the mixer and out through the stack. The temperature of these gases, as they emerge from the drier and pass through the mixer, is rarely above three hundred degrees, Fahrenheit, so that they cannot possibly have any deleterious effect on the asphalt cement in the batch being mixed in the mixer.

The batch or charge is held in the drier until it is perfectly dry and is heated to the right temperature. The time required to perform these operations is practically the same for each batch during the day on account of the positive uniformity of the heat from the oil burning in the combustion tube, and also on account of the close uniformity of the moisture content in the mineral aggregate as it is in the storage piles, so that if the necessary time is once determined, the temperature regulation of the paving mixture is very simple and the variation in temperature of the mixture during the course of the day will be very small.

The temperature of the sand in the drier can be obtained by allowing small quantities to discharge out from the drier through the mixer when the mixer is empty, and these samples can then be tested with a thermometer. When the charge in the dryer is dry and hot enough, it is discharged into the mixing compartment and the required weight of asphalt cement is dumped into the mixer at the same time.

The drying compartment is comparatively small in diameter, and long, while the mixing compartment is comparatively large in diameter and short, the requirements for the two operations being radically different. In order to dry economically it is necessary to have the sand spread out in a long, comparatively thin ribbon, so that the material which is thus distributed the whole length of the cylinder cascades as often as possible through the hot gases during their passage through the drier.

In the mixer, however, it is necessary to keep the contents in a close and compact body, in order not only to thoroughly and uniformly coat each of the particles of mineral aggregate with an even and uniform thickness of asphalt cement, but also to evenly distribute the different sizes of particles throughout the entire mass, as well. In order to accomplish these results, the interior of the mixing compartment is equipped with a worm conveyor which is riveted to the outside shell, which tends to work the mass toward the discharge opening, and superimposed, is another spiral conveyor which, working in the top of the mass, tends to convey it back toward the diaphragm between the mixer and the dryer. In this way the contents of the mixer get not only the keading action due to the cascading of the mass on itself, but they are also folded back continuously by the superimposed spiral conveyor.

The contents of the mixer are discharged directly into the motor trucks or wagons by means of the tilting chute shown in Figure No. 1. The material is elevated and dropped onto this chute by means of lifting trays next to the discharge opening. This gate is also controlled by the mixer man from the mixer platform. The asphalt cement is weighed out for each batch in the asphalt weighing bucket, which has already been described, and is discharged into a funnel on the side of the mixing compartment. The asphalt cement is then led into the interior of the mixer by means of a pipe running from the bottom of this funnel.

The drying operation usually takes, with average sand, from five to six minutes, varies slightly according to the moisture content. To empty the dry and hot sand from the drier into the mixer takes from one and one-half to two minutes, so that a three-thousand-pound batch of mineral aggregate is run into the drier every seven to eight minutes, and batches of the mixture can be run into the trucks or wagons at the same rate. The mixing operation requires about three minutes and it usually takes about two minutes to empty the mixer into the truck or wagon.

When the plant is being run continuously, it will be seen that there is sufficient time for the operator to allow the contents of the mixer to properly mix and discharge before the charge in the dryer is ready to transfer, without slighting the mixing operation.

It will, therefore, be seen that the time required for each operation permits the several operations to take place in their proper sequence without in any way interfering with each other, or from preventing the full capacity of the plant from being realized, which is, in itself, a most important point for consideration.

The manufacturers of the Warren Portable Asphalt Plant claim many advantages for this plant over the older types of paving plants. They claim that the plant costs less in the first place than do the older and more cumbersome types, and that the amounts to be paid in freight and for erection and dismantling when it has to be moved from one place to another will be found to be considerably lower. It is also claimed that on account of its real portability it can be used in many places where it would not be possible to move and use one of the older types of plants, or where it would not, considering the size of the job, or the location, be economical to set up one of the plants of the latter type.

The Warren Brothers Company, Boston, Mass., manufacturers of the plant, which is now in use in all parts of the United States, briefly summarize its advantages as follows:

1. It is simple in construction.
2. It is easy to operate.
3. It costs less per ton of mixture to mix than any portable plant.
4. It is more portable than any other portable plant.
5. It does not require as many expert attendants to operate as other portable plants.
6. It is the pioneer portable asphalt plant, and has been tried out thoroughly under all possible working conditions.
7. It can rework old asphalt pavement for use in making repairs, which no other plant can do.
8. It has laid more finished pavement than all other portable plants combined, and the high quality of its product is verified by the test of time.
9. It has the largest capacity of any portable plant, based on actual performances, and not estimated results or one-hour tests.

(*Continued on page* 42.)

# Conclusion of the Report of Committee D-4 of the American Society for Testing Materials

WE present herewith the conclusion of the important report of Committee D-4 of the American Society for Testing Materials, with the proposed revised standard and the tentative methods for making various tests, as adopted by letter ballot of the society on September first. The balance of this report, which is one of the most important that has ever been made on road materials by an engineering society of high standing, was published in the July, August, and September issues of BETTER ROADS AND STREETS.

The American Society for Testing Materials, with headquarters at the University of Pennsylvania, Philadelphia, Pa., has undoubtedly done more work toward standardizing tests on bituminous and other road materials than any other society in the country. This work has all been done through Committee D-4, as the road material committee is officially ated, and this committee deserves a great deal of un- d credit for its accomplishments.

Its work is not completed, by any means, and there will be no cessation in its efforts during the next few years at least. It is only a few years ago that little attention was paid to standards and standard tests for road materials, and the result was that there would be a wide variance in results when the same sample was tested by different laboratories. This was due to the wide difference in the methods and the apparatus used. But, very fortunately, this is not the case to-day, when a sample can be divided into several parts, one of which may be analyzed and tested in New York, another in New Orleans, another in Los Angeles, and another in Milwaukee, and practically the same determinations arrived at in each of these cases. This is due to the standardization of methods and apparatus, and the increased care that is given to such tests and analyses. And the American Society for Testing Materials is responsible for this advanced condition.

The balance of the methods of testing as discussed at the Atlantic City meeting of the society the last week in June, and classed as proposed revised standard methods, or tentative methods, are presented herewith.

## PROPOSED REVISED STANDARD METHOD FOR MAKING A MECHANICAL ANALYSIS OF SAND OR OTHER FINE HIGHWAY MATERIAL, EXCEPT FOR FINE AGGREGATES USED IN CEMENT CONCRETE.

### SERIAL DESIGNATION: D7—16

(This method is issued under the fixed designation D7. The final number indicates the year of original issue, or in the case of revision, the year of last revision.)

### ADOPTED, 1911; REVISED, 1916.

The method shall consist of:

(1) Drying at not over 110 degrees Centigrade (230 degrees Fahrenheit) to a constant weight, a sample weighing 50 grammes.

(2) Passing the sample through each of the following mesh sieves, which are the American Society for Testing Materials standard sieves:

| MESHES PER LINEAR INCH (=2.54 centimeters) | DIAMETER OF WIRE | |
|---|---|---|
| | INCHES | MILLIMETERS |
| 10 | 0.027 | 0.6858 |
| 20 | 0.0165 | 0.4191 |
| 30 | 0.01375 | 0.34925 |
| 40 | 0.01025 | 0.26035 |
| 50 | 0.009 | 0.22865 |
| 80 | 0.00575 | 0.1460 |
| 100 | 0.0045 | 0.1143 |
| 200 | 0.00235 | 0.05969 |

The order in which the sieves are to be used in the process of sifting is immaterial and shall be left optional, but in reporting results, the order in which the sieves have been used shall be stated.

(3) Determining the percentage by weight retained on each sieve, the sifting being continued on each sieve until less than one per cent. of the weight retained on each sieve shall pass through the sieve during the last minute of sifting.

(4) Recording the mechanical analysis in the following manner:

| | PER CENT. |
|---|---|
| Passing 200-mesh sieve | =——— |
| Passing 100-mesh sieve and retained on a 200-mesh sieve | =——— |
| Passing 80-mesh sieve and retained on a 100-mesh sieve | =——— |
| Passing 50-mesh sieve and retained on a 80-mesh sieve | =——— |
| Total | =100.00 |

## PROPOSED STANDARD METHOD FOR DISTILLATION OF BITUMINOUS MATERIALS FOR ROAD TREATMENT.

### SERIAL DESIGNATION D—20—16.

This method is issued under the fixed designation D-20. The final number indicates the year of original issue, or in the case of revision, the year of last revision.

### ADOPTED, 1916.

1. The sample, as received, shall be thoroughly stirred and agitated, warming, if necessary, to insure a complete mixture before the portion for analysis is removed.

2. If the presence of water is suspected or known, the material shall be dehydrated before distillation. About five hundred cubic centimeters of the material are placed in an eight hundred cubic centimeter copper still provided with a distilling head connected with a water-cooled condenser. A ring burner is used, starting with a small flame at the top of the still, and gradually lowering it, if necessary, until all the water has been driven off. The distillate is collected in a two hundred cubic centimeter separatory funnel with the tube cut off close to the stop-cock. When all the water has been driven over and the distillate has settled out, the water is drawn off and the oils returned to the residue in the still. The contents of the still have cooled to below one hundred degrees Centigrade before the oils are returned, and they shall be well stirred and mixed with the residue.

3. The apparatus shall consist of the following standard parts:

(a) FLASK—The distillation flask shall be a 250 cubic centimeter Engler distilling flask, having the following dimensions:

| | |
|---|---|
| Diameter of bulb | 8.0 centimeters |
| Length of neck | 15.0 centimeters |
| Diameter of neck | 1.7 centimeters |
| Surface of material to lower side of tubulature | 11.0 centimeters |
| Diameter of tubulature | 0.9 centimeters |
| Angle of tubulature | 75 degrees |

A variation of three per cent. from the above measurements will be allowed.

(b) THERMOMETER—The thermometer shall be made of resistance glass (Jena 59=Jena 19—Verra dur are suggested); it shall be filled with carbon dioxide under pressure of one atmosphere at three hundred degrees Centigrade, and shall be provided with expansion bulb at the top; it shall be annealed at 400 degrees Centigrade for ninety-six hours, and slowly cooled; it shall be graduated in single degrees Centigrade from —5 degrees Centigrade to +400 degrees Centigrade; the length of the graduations from 0 to 400 degrees Centigrade shall be 300 millimeters (plus-or-minus 10 millimeters); the diameter of the stem shall be 7 millimeters (plus-

(*Continued on page* 42.)

# Meeting of the New York State Association of County Highway Superintendents

THE summer meeting of the New York State Association of County Highway Superintendents was held in the assembly room of the Onondaga County Court House, Syracuse, New York, September 13 and 14, with a full attendance from all parts of the State. Sessions were held only in the mornings, as arrangements had been made for numerous trips over the many well-built roads of Onondaga County, to the large stone quarries operated by the county, and to the four prison labor camps that have been in operation all summer. One afternoon was devoted to a visit to the New York State Fair, one of the largest of the kind held in this country, and where there were exhibits of road machinery by a large number of well-known manufacturers and dealers, many of whom were giving actual demonstrations. The New York State Commission of Highways and the Office of Public Roads and Rural Engineering, Washington, also had extensive exhibits, which were centers of great interest.

The sessions were presided over by James F. Loughran, County Highway Superintendent of Ulster County, and president of the association. Owing to the fact that there were several of the members absent who were on the published program, merely an informal program was carried out, the discussions being general on all subjects of interest to the county officials. The subjects discussed were as follows:

1. "Taking the Office of Town Superintendent Out of Politics, Lengthening the Term of Service, and Making Removal a More Simple Matter."
2. "Uniform Prices of Machinery."
3. "The Use of Automobile License Fees in County Road or Township Highway Construction and Maintenance."
4. "The County as a Unit in the Administration of Highway Affairs."
5. "County Road Construction and Maintenance."
6. "Is It Advisable to Increase the Carrying Capacity of New Steel and Concrete Bridges?"
7. The Class of Road or Pavement Which Will be Most Advantageous to the Towns and the Counties."

In addition to the subjects named, there was an open discussion for all subjects and a long and particularly interesting address by Commissioner Edwin Duffey, of the New York State Commission of Highways, the latter talk being the feature of the meeting.

George C. Diehl, County Superintendent of Highways of Erie County, Buffalo, New York, delivered a most interesting talk on "The County as a Unit in the Administration of Highway Affairs," and pointed out the many advantages of this unit. The plan met with favor, as it should, and wherever it has been tried out, it has proven a complete success, with a county system of fine roads and no great delay through being forced to wait long periods for permission to go ahead. Mr. Diehl put a lot of good, sound logic into his talk, and it carried particular weight, coming from him, as he is recognized throughout New York State as a man more familiar with highway matters and problems than any other man in the State.

Another very interesting subject discussed was "County Road Construction and Maintenance," by J. C. Dayton, County Superintendent of Highways of Cayuga County. Mr. Dayton has built up a system of fine county highways, and the methods employed are so interesting that they will be published in a separate article in Better Roads and Streets.

One thing that was particularly noticeable in the remarks of the different county superintendents who told of what they are doing in their respective counties is the fact that the water-bound macadam road, which years ago was the popular type, is again becoming the popular type, and this in the face of the rapid increase of motor traffic. The macadam type of road, built either with limestone, trap rock, or slag, has proven itself to be an economical road in the end, as it is not difficult or over expensive to keep in condition under the modern systems of maintenance that are now in force throughout every section of the entire State. Many of the counties are building the bottom course, for practically all the macadam roads in New York are of two-course construction, out of the native stone that can be had right along the road, or within a very short haul, and then using the better grades of stone, which must be brought, in many cases, from other parts of the State, in the top course. This practice is resulting in getting county roads at a low cost, and with all the wearing qualities of a road built of the better grades of stone throughout. Many of the roads so built are treated with Tarvia, and are giving generally complete satisfaction. In some cases they are oiled the year after they are built, and then the following year given a light surface treatment. Many of the counties are contemplating the purchase of modern equipment, and this will be rented to the towns in the respective counties for street improvement.

Commissioner Edwin Duffey, in his address, praised the conference and said that he would not only always give it his hearty approval, but that he would, if necessary, cancel all other engagements to attend, as he considers it the most important road meeting held in the State. He impressed upon the members of the association his desire to have them come to Albany oftener, as he wishes the State Department and the counties to become closer related, as in this day of real road-building, the County Superintendent of Highways is the most important civil officer in the county, and really works one-fourth for the State and the remaining three-fourths for the county.

He complimented the superintendents upon the splendid relation that there is between the State Commission of Highways and themselves by saying that since he has been in office, there has not been a single case where there has been a clash between the county superintendent and his offices. He impressed upon them that owing to the fact that there will be so much construction during the next few years, there must be absolute co-operation between the two units.

Commissioner Duffey stated that the counties have already constructed about five thousand miles of improved roads, and the State about seven thousand miles, or a total of twelve thousand miles. And that during the next three years, possibly less, there will be an additional three thousand miles constructed by the State and the counties. Of the eighty thousand odd miles of roads in New York State, probably thirty to forty thousand miles are relatively unimportant and serve only a few persons who live on them. So that there will be, at the end of two or three years, only about one-third to one-half of the important road mileage completed. This leaves a large amount of work still to be done. He explained the eagerness of the people of the State to come forward and insist upon the improvement of the roads, and their offers to help pay for them. This can only mean that the people are not going to be satisfied until there is a complete, improved road system that will cover all sections of the State. That the New York State roads are now being appreciated is evidenced by the fact that there has been, last year and this year, a tremendous amount of automobile tourist traffic from other States in every part of the country, who are anxious to visit the hundreds of summer resorts, lakes, and points of historical and scenic interest, in which the Empire State is so rich.

Commissioner Duffey praised Onondaga County, of which Syracuse is the county seat, stating that no other county in the State has done more or better work in the construction of its system of highways than has Onondaga County, the principal credit for which is due to the untiring effort of Superintendent of Highways, Frank E. Bogardus.

State highway construction work all over the State, Commissioner Duffey stated, is far behind where it should be this year, owing to the scarcity of labor. There are only twenty thousand men at work now, whereas there should be, for the work already awarded, at least sixty thousand. Wages are high and the prices of materials are higher than they have been in other years, so that the State is getting a smaller mileage for the money than in the past. It is impossible to get stone

(*Continued on page* 45.)

# Last Year's Accomplishments of the Division Engineers of the Department of Construction of the New York State Commission of Highways

By George D. Steele

NEW YORK STATE has to-day, after years of attempt, what is considered the best organized and most efficient State Highway Department in the country. That there are ample grounds for this statement, is borne out by actual figures of what has been done during the years gone by, costs of construction, etc., as compared with what was done last year, and what is being done this year. The work this year will not, in volume and cost, show up as favorably at the close of the construction season as it did last year, but this is the direct result of labor. There was a scarcity of labor last year, some 150,000 alien laborers having left the State to return to the warring European nations. Conditions this year are much worse, however, and there are no contractors in the State who have been able at any time this year to secure more than seventy-five per cent. of the actual number of men needed on their road contracts. The wages demanded by what labor can be secured, too, are much higher than were paid last year, and still higher than the wages paid in previous years. So that for many reasons, it will be impossible to construct as much road this year, or to construct it for as low a cost per mile. This article will, however, take up only the work of the New York State Commission of Highways by divisions for the year 1915, the figures for which have just become available.

The State is divided into nine division highway districts, each of which has its own office, in charge of a division engineer, who has under him such engineers and office help as occasion and the work being done demands. The offices are in direct charge of resident engineers, who are in reality, assistants to the district engineer. The work of these various divisions will be taken up in order.

### Division No. 1.

B. H. Wait is in charge of Division No. 1, with headquarters at Poughkeepsie. The division includes the counties of Columbia, Dutchess, Greene, Nassau, Orange, Putnam, Rockland, Suffolk, Ulster, and Westchester. This is one of the most important divisions of the State, lying directly north of New York City, and through it passes all traffic to Albany and way points, Connecticut, Rhode Island, and Massachusetts points, summer traffic and tourists to the hundreds of New England coast and mountain resorts, and a heavy suburban residence traffic.

The roads completed last year consist of the following types of construction, together with the average costs per mile of the various types:

| | PER MILE |
|---|---|
| 14.6 miles of water-bound macadam at | $8,700.00 |
| 40.2 miles of bituminous macadam, penetration method, at | 11,400.00 |
| 3.7 miles of bituminous macadam, mixed method, at | 14,100.00 |
| 40.8 miles of cement concrete pavement, at | 10,700.00 |
| 7.9 miles of brick pavement, at | 38,700.00 |
| 3.3 miles of asphalt block pavement, at | 22,300.00 |
| .4 miles of stone block pavement, at | 34,300.00 |

The excessive cost of brick and asphalt block pavement is due to extra width of pavement beyond the sixteen feet that is paid for by the State, and also for extra work on street-surface railroads in villages and towns.

The following statement shows the average cost per mile for a pavement of the different types, this width being the portion for which the State pays:

| | |
|---|---|
| 7.9 miles of brick pavement, at | $28,400.00 |
| 3.3 miles of asphalt block pavement, at | 19,900.00 |

The high cost of the brick type of pavement is due to heavy excavation and concrete walls which occurred on roads which were improved with this type of pavement. The low cost of the asphalt block type is due to the fact that old and worn-out macadam was used as the foundation on a part of the mileage.

The average cost per mile of the State's share of the completed contracts was $12,400, which average cost covers roadways of all types.

The following table shows the uncompleted roads by types, with the condition of the work at the beginning of the present year:

| | PER CENT. COMPLETED |
|---|---|
| 42.2 miles of water-bound macadam | 7 |
| 94.9 miles of bituminous macadam, penetration method | 15 |
| 11.6 miles of bituminous macadam, mixed method | 73 |
| 27.8 miles of cement concrete pavement | 8 |
| 0.2 miles of brick pavement | 0 |

A summary of the work of Division No. 1 shows that there was completed during 1915, a total of about 111 miles of all types, and that there remained uncompleted at the close of the year and under contract, about 177 miles of highway, of which about seventeen per cent. may be considered completed work.

### Division No. 2.

Division No. 2 includes the counties of Albany, Rensselaer, Schenectady, Saratoga, Washington, Warren, Essex, and Clinton. The division is in charge of H. O. Schermerhorn and the headquarters are at Albany. The roads completed during 1915 consist of the following types of construction, and the average costs per mile:

| | PER MILE. |
|---|---|
| 33.58 miles of water-bound macadam, at | $10,050.00 |
| 42.04 miles of bituminous macadam, at | 9,567.00 |
| 6.45 miles of cement concrete, at | 12,648.00 |
| 1.34 miles of brick pavement, at | 47,269.00 |
| 0.61 miles of asphalt block pavement, at | 68,782.00 |

The average cost per mile of the completed work during 1915 was $11,028.00, of which the State's share was approximately $10,649.00.

The low cost of the bituminous macadam type road and the low average cost per mile is due principally to the fact that there is included in the bituminous macadam group 6.77 miles, which is practically a resurfacing contract, and also to the excessively low contract price bid on 11.83 miles of this type of road completed in Clinton County.

The uncompleted roads with the state of work thereon is as follows:

| | PER CENT. COMPLETED |
|---|---|
| 26.56 miles of water-bound macadam | 34 |
| 3.83 miles of bituminous macadam | 43 |
| 0.09 miles of cement concrete | 15 |

The summary for Division No. 2 shows that the total mileage completed during 1915 amounts approximately to 84.02 miles, and that the uncompleted work that was under contract at the beginning of this year amounts to 86.56 miles, of which 35 per cent. had been completed at the close of the construction season.

### Division No. 3.

Division No. 3 comprises Franklin, Jefferson, Lewis, and St. Lawrence counties, and is in charge of Theron M. Ripley, with headquarters at Watertown. The mileage and cost per mile of the roads completed during 1915, with the types of each, were as follows:

| | PER MILE |
|---|---|
| 40.17 miles of water-bound macadam, at | $8,189.00 |
| 85.84 miles of bituminous macadam, at | 10,047.00 |
| 3.32 miles of brick pavement, at | 32,436.00 |
| 7.16 miles of cement concrete pavement, at | 11,499.00 |
| 0.58 miles of bitulithic pavement, at | 39,948.00 |

The excessive cost of the construction of some of the roads and types, as shown above, is due to the necessity of

widening out in villages and towns through which the State roads pass. The following tabulation gives the cost per mile, with the widenings through the villages and towns omitted:

| | PER MILE |
|---|---|
| 40.17 miles of waterbound macadam, at | $ 8,189.00 |
| 85.84 miles of bituminous macadam, at | 10,047.00 |
| 3.32 miles of brick pavement, at | 30,194.00 |
| 7.16 miles of cement concrete pavement, at | 11,189.00 |
| 0.58 miles of bitulithic pavement, at | 13,972.00 |

The uncompleted roads, for which contracts were let during the year, with the amounts completed up to the close of the construction season, by types, were as follows:

| | PER CENT. COMPLETED |
|---|---|
| 14.73 miles of water-bound macadam | 56 |
| 61.19 miles of bituminous macadam | 30 |
| 2.05 miles of brick pavement | 92 |
| 14.30 miles of cement concrete pavement | 44 |

The total completed work for the year in Division No. 3 amounts to approximately 137.07 miles, and the uncompleted contracts amount to, up to the close of the construction season, 92.27 miles, of which there is approximately 41 per cent. completed.

The average cost of the completed work in 1915 was $10,248.00 per mile, including the widenings through villages and towns, while excluding these widenings, the average cost per mile is $10,067.

### Division No. 4.

Division No. 4 includes Fulton, Hamilton, Herkimer, Madison, Montgomery, and Oneida counties. It is in charge of J. H. Sturdevant, with headquarters at Utica.

The completed roads, constructed in 1915, consist of the following types of construction:

| | PER MILE |
|---|---|
| 21.94 miles of water-bound macadam, at | $10,600.00 |
| 11.60 miles of bituminous macadam, at | 11,600.00 |
| 2.42 miles of cement concrete pavement, at | 15,370.00 |
| .90 miles of bithulithic pavement, at | 52,500.00 |
| .09 miles of gravel road, at | 62,470.00 |

The average width of the bitulithic pavement is thirty feet, and it was built with a concrete curb. The State's share amounted to $11,500.00 per mile. The excessive cost of the short section of gravel road constructed was due to the heavy grading that was necessary on a newly-located cut-off.

The uncompleted contracts as of January 1, 1916, embraced the following types:

| | PER CENT. COMPLETED |
|---|---|
| 148.18 miles of water-bound macadam | 34 |
| 6.33 miles of bituminous macadam, penetration method | 92 |
| .32 mile of concrete foundation | 74 |
| .70 mile of bituminous macadam, mixed method, Type 2 | 00 |
| .19 mile of stone block pavement | 66 |

The total mileage of uncompleted roads amounts approximately to 37 miles. There are 156 miles under contract, of which approximately 33 per cent. are completed.

The average cost of completed work amounts to $12,450 per mile. This average was raised considerably on account of the bitulithic pavement built, part of the cost of which was borne by the city corporation, and on account of the gravel roadway, as already mentioned.

### Division No. 5.

Division No. 5 includes Broome, Chenango, Delaware, Otsego, Schoharie, and Sullivan counties. The division is in charge of Howard E. Smith, with headquarters at Binghamton. The roads completed during 1915 consisted of the following mileage and types of construction:

| | PER MILE |
|---|---|
| 51.50 miles of water-bound macadam, at | $11,900.00 |
| 28.29 miles of bituminous macadam, penetration method, at | 14,100.00 |
| 1.56 miles of bituminous macadam, Type 2, mixing method, at | 31,400.00 |
| 0.68 mile of cement concrete pavement, at | 18,800.00 |
| 8.54 miles of Hassam grouted concrete pavement, at | 18,800.00 |
| 3.87 miles of brick pavement, at | 49,200.00 |

The excessive costs of the bituminous macadam, Type 2, mixing method pavement, and of the brick pavement, were due to additional widths in the villages of Monticello, New Berlin, and Union, and in the city of Binghamton, which, if deducted, would reduce the cost of the State's share of the bituminous macadam, Type 2, mixing method pavement, to $16,600 per mile, and of the brick pavement to $21,500 per mile.

The above figures, for the cost per mile of water-bound macadam, bituminous macadam, and brick, include the cost of work done upon the original contracts for highways numbers 5,240, 5,247, and 5,243, and also the cost of the work under subsequent contracts covering the completion of these respective roads.

One road, on which the Hassam grouted concrete pavement was completed in 1913, was not accepted finally by the State until 1915.

The uncompleted roads, as of January 1, 1916, embrace the following types:

| | PER CENT. COMPLETED |
|---|---|
| 38.23 miles of water-bound macadam | 45 |
| 95.41 miles of bituminous macadam, penetrat'n method | 49 |
| 3.22 miles of sub-base bituminous macadam | 93 |
| 11.77 miles of second-class cement concrete pavement with bituminous surface | 63 |
| 1.29 miles of brick pavement | 53 |

The total completed work amounted in 1915 to approximately ninety-four miles, at a total average cost of $15,200 per mile, or deducting additional widths in villages and cities, at an average cost of $18,300 per mile.

The uncompleted work under contract amounts to approximately 150 miles, of which about fifty per cent. had been completed up to the beginning of the present year.

### Division No. 6.

The counties included in Division No. 6 are Cayuga, Cortland, Onondaga, Oswego, Seneca, and Wayne. W. M. Acheson is in charge of the division, with headquarters at Syracuse.

The construction work for 1915 consisted of the following types and mileages:

| | PER MILE |
|---|---|
| 16.62 miles of water-bound macadam, at | $11,000.00 |
| 21.47 miles of bituminous macadam, at | 11,200.00 |
| 9.60 miles of cement concrete pavement, at | 13,500.00 |
| 1.16 miles of brick pavement, at | 25,500.00 |
| 0.68 mile of stone block pavement, at | 38,500.00 |
| 8.22 miles of Hassam concrete pavement, at | 11,200.00 |

The stone-block pavement that was constructed, was principally in the southern section of the city of Syracuse, where granite block was used on a steep grade. There was a long haul for materials, which accounts for the high cost per mile for this type of paving.

Uncompleted roads on January 1, 1916, embraced the following types and mileages:

| | PER CENT. COMPLETED |
|---|---|
| 18 miles of water-bound macadam | 30 |
| 53 miles of bituminous macadam | 40 |
| 10 miles of cement concrete pavement | 60 |
| 2 miles of brick pavement | 50 |

The total mileage of roads completed during the year was 57 miles, and the total mileage of uncompleted roads under contract is approximately 83 miles, of which 40 per cent. had been completed up to the beginning of this year, but not included in the mileage of completed roads.

The average cost per mile, including all types, was $12,100 for completed roads. This includes all charges for engineering, but excludes work done and paid for by incorporated villages.

### Division No. 7.

The counties included in Division No. 7 are Genesee, Livingston, Monroe, Ontario, Orleans, and Wyoming. The division is in charge of Perry Filkin, with headquarters at Rochester.

The roads completed during 1915 consist of the following types of construction, mileage, and costs per mile:

| | PER MILE |
|---|---|
| 3.95 miles of brick, at | $22,350.00 |
| 6.07 miles of Hassam concrete, at | 12,520.00 |
| 0.73 mile of bituminous macadam, mixed method, type 2, at | 18,700.00 |

(*Continued on page 46.*)

# National Old Trails Fifth Annual Convention

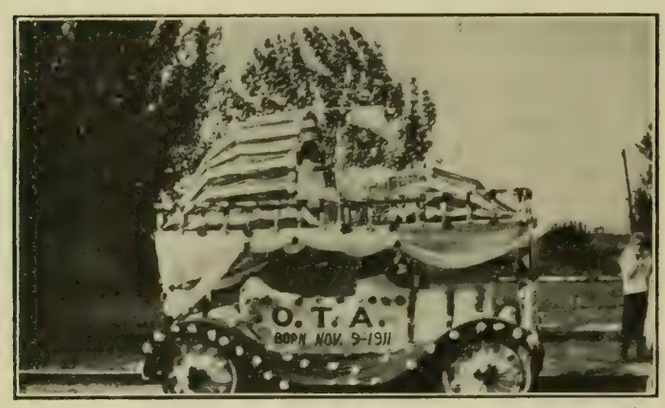
Herington, Kansas, September 14 and 15, 1916

CHARACTERIZED by Judge Lowe as the greatest convention ever held, enthusiastic but well organized, and before its conclusion the enthusiasm was directed into real road-building channels.

A parade of automobile delegations, bands, and floats was the feature of the first morning, and while this was, to some extent, of a local nature, still cars were present from as far as one hundred and sixty miles. The largest delegations were from the towns of Mariona and Council Grove, each of which contained about sixty-five cars, and each delegation was headed by a brass band. Burdick, Lost Springs, Hillsboro, and Herington delegations were also each headed by a brass band. The float of the Childs Furnishing Goods Company, representing the Cradle of the Old Trail, was attractive, unique, and appropriate, and easily captured the prize as the best float in the parade. At Herington, on November 9, 1911, and before any national movement had been organized, was perfected the Kansas Old Trails Association that afterward became the Kansas Division of the National Old Trails Association.

Four hundred cars were in the parade, and seven hundred cars were in town.

Judge Lowe presided at all sessions of the convention, and the Official Music Box, the Old Trails Quartet, enlivened all sessions with selections, the most popular of which was their rendition of the imitation of a steam calliope, which they were compelled to repeat again and again.




**First Prize Float. Childs Haberdasher Company**

E. E. Peaks, secretary of the Kansas City Auto Dealers' Association, in his address, asked the members of the convention how many of them would put a paper roof on his house, and compared the present work on the dirt roads to a paper roof which would be washed away by the first rain.

Judge Lowe remarked on the great number of banners in the parade advocating Rock Roads, Cement Culverts, and Permanent Roads, and was elated that dirt roads were not mentioned during the convention.

W. S. Gearhart, Kansas State Highway Engineer, talked of needed legislation in Kansas, and in urging for a State Commission, pointed out how hard it is to make the county highways of one county match up with the county highways of its adjoining counties without some centralized authority.

Robert Bruce, of Clinton, New York, special representative of the National Highways Association, who had just driven over this road from New York, made special note of the lack of interest in this project along the Illinois Division.

Mrs. John Van Brunt, of Kansas City, a member of the Good Roads Committee of the National Society of the Daughters of the American Revolution, assured the convention of the continued interest of that society in this movement.

C. E. McStay, of Los Angeles, special representative of the Auto Club of Southern California, told of counties in California that had been able to build and maintain hard-surfaced roads for less money per year than the dirt roads had previously cost them.

At the business session of the convention the second morning, Kansas arose to its opportunity and came before the national convention with a plan to hard-surface the five hundred miles of the road in that State at once. The enthusiasm of the previous day's meeting, which is believed to have reached a record in numbers and noise, was repeated when the report came in. The plan calls for five commissioners, Kansas men, to have charge of the campaign. They are to get the approval of the State Highway Engineer and the United States Secretary of Agriculture for the improvement of the entire Old Trails Road in Kansas, so that Federal aid will be assured, and then go to the towns and land owners along the line. Local organizations are to be formed. In the rural districts the Hodges Road Law will be used and in the towns, the paving laws. County commissioners will be asked to pay at least twenty-five per cent. of the cost of the road. In this way it is believed that the cost to the adjacent land owner will be reduced to a very low figure.

As a club to insure co-operation of the backward localities, a provision was adopted whereby the route may be changed.

"Build it or lose it," will be the motto.

The problem heretofore has been to arouse public sentiment to the point where the ones who must pay for the improvements were desirous that the work proceed and the outpouring of delegates to this convention and their unmistakable enthusiasm shows that the time has arrived.

Thirty-three towns of Kansas had over five hundred delegates registered at this convention, and the attendance was probably three thousand.

Time and place of next convention was left in the hands of the Executive Committee, with suggestion that it be called in Illinois.

WHEREAS, The city of Herington has welcomed the Old Trails Association by the most enthusiastic and largest reception ever given it during its existence, and the city of Herington and surrounding country have shown their appreciation for the work the Old Trails Association is trying to accomplish by organizing an automobile parade of more than five hundred automobiles, accompanied by bands from every surrounding town, to welcome the members of this organization; and,

WHEREAS, The citizens of Herington have extended to the members of this association the most hearty welcome that they have ever received, and by the enthusiasm displayed by the citizens of Herington, have cheered and encouraged the members of this association on to a renewed effort to accomplish their ends; and,

WHEREAS, The citizens of Herington have been able to entertain and care for all visiting members of this organization, and provided for their comfort and entertainment while in the city, furnishing splendid music with their well-organized quartet during the meetings of this association. Therefore, be it

*Resolved,* That we members of the Old Trails Association, in convention assembled, express our gratitude to the citizens of Herington for the manner in which they have so cordially welcomed and so splendidly entertained the largest and most enthusiastic annual meeting of the Old Trails Association ever held.

WHEREAS, The County Commissioners of Marion, McPherson, Dickinson, and Morris counties have exercised splendid judgment and economy in the construction of permanent cement crossings on the Old Trails Road running through said counties. Therefore, be it

*Resolved,* That this, the Old Trails Association, extend to the County Commissioners of the counties named, the thanks of this organization for the splendid judgment exercised by them in making these permanent improvements on the Old Trails Highway.

*Resolved,* That we congratulate this association on the friends it has made among other associations, and particularly do we mention that splendid association in Los Angeles known as the Automobile Club of Southern California, for being one of the few automobile clubs that has any appreciation of what such clubs should stand for. Too much credit cannot be given

this great club for its really wonderful work in the cause of good roads, and especially do we express our appreciation of the signposting of the National Old Trails Road by this club from Kansas City to Los Angeles, in co-operation with this association.

*Resolved,* That we express our appreciation of the excellent historical sketch of that part of the Old Trails Road from Washington to Wheeling, written by Robert Bruce of Clinton, New York, and published in co-operation with the National Highways Association.

We most heartily commend this book. It should be in the hands of everybody and we sincerely hope that its author may receive such encouragement that he will continue this splendid work throughout the length of the Old Trails Road.

*Be It Resolved,* That for loyal, steadfast devotion to the cause of good roads everywhere, we commend the National Highways Association and its great president, Charles Henry Davis, who has given so lavishly and unselfishly of both time and money to this cause. No other association has approximated its vast appropriation of money or the great educational work it has accomplished. When other associations have grown lukewarm and discouraged, the National Highways Association and the National Old Trails Association, a department thereof, have remained in this great field of useful endeavor, contending all the more earnestly for the great ideals for which we mutually stand.

WHEREAS, The great enterprise of restoring and extending across the United States of the national highway, or series of national highways and trails that in earlier days constituted the line of intense life and romance of our westward marching civilization, requires co-operation, mutual appreciation, vision, reverence, and courage; and,

WHEREAS, The Citizens Bridge Committee of Richmond, Indiana, with a fine appreciation of responsibility to a cause that is not altogether local, have labored courageously to build a splendid memorial bridge in Richmond. Therefore, be it

*Resolved,* That the National Old Trails Road Association, in convention assembled at Herington, Kansas, commend the foresight, patriotic purpose, and co-operative spirit of the citizens of Richmond, and recommend their example to communities along the line for their emulation.

AMENDING THE CONSTITUTION OF THE NATIONAL OLD TRAILS ROAD ASSOCIATION.

WHEREAS, It is deemed fit and proper that this National Convention officially recognize the enameled markers made and placed by the Auto Club of Southern California, and now designating a considerable part of the National Old Trails Road; and,

WHEREAS, The placing of these enameled metal markers along certain selected and accepted routes has been done at a comparatively recent date, and since action on the constitution has been taken, now, therefore, be it

*Resolved,* That Section No. 1 of Article No. 2 of the Constitution of the National Old Trails Road Association be and the same is hereby amended to read as follows:

"The object of this association shall be the marking and construction of a modern road, worthy of its memorial character, along the line of the Braddock Road from Washington, D. C., to Cumberland, Maryland, as it is now laid out by the State of Maryland, and traveled to-day; the National Pike from Cumberland, Maryland, to St. Louis, Missouri, as it is now improved by the various States through which it passes; the Missouri Cross State Highway (approximating the Boone Lick and Santa Fe Trail roads) as they are now marked by the National Old Trails enameled metal markers from St. Louis to Kansas City, Mo.; the National Old Trails Road (approximating the Santa Fe Trail) from Kansas City, Missouri, to Santa Fe, New Mexico, as it is now marked by the National Old Trails enameled metal markers; and branch roads similarly signposted in Colorado; Santa Fe, New Mexico, to Los Angeles, California, as signposted via both the Gallup and Springerville routes"; and further be it

*Resolved,* That section No. 2 (which is now eliminated) be supplied to read as follows:

"If any particular part of these before mentioned and designated official routes should for any reason be allowed to get into disrepute because of their not being kept up to an acceptable condition for any considerable time, the route may be changed *temporarily* by the Executive Committee of this association, or their duly appointed representative, but such temporary change, to become permanent, must be approved by a two-thirds vote of the next national meeting of this organization, and notice of contemplated action of such a change of route must be contained in the call for the convention."

After due deliberation and realizing fully our responsibility to this convention to devise a workable plan for accomplishing the permanent hard surfacing of the National Old Trails Road across Kansas, thereby perpetuating for all time to come the Old Santa Fe Trail, so rich in its historic associations and so dear to the Kansan of to-day, we do recommend that this convention adopt substantially the following provisions that we deem essential to the prompt accomplishment of this purpose.

First. That a commission of five members of this association, now actual residents on the road as marked through Kansas, be named by the president of this association to take up this work systematically with the various counties and cities through which the National Highway, as now adopted and marked, exists as a temporary monument.

Second. That this commission be authorized to confer and arrange with the Kansas State Engineer a plan of permanent surfacing that will secure his endorsement, together with the endorsement of the Secretary of Agriculture, and thereby be assured upon completion of fifty per cent. of its cost from the Federal Government.

Third. That this commission be authorized to make assessments upon the urban population touched and benefited by this road, as will be necessary to carry on the work of securing the necessary signatures of the individuals necessary under the Hodges Law and the adoption of paving in cities and villages for the cost of the other fifty per cent. of the road.

Fourth. That this commission be authorized, with the counsel and advice of the president and secretary of the association, to make such deviation from the present adopted and marked road as may be absolutely necessary to secure the endorsement and building of one-half its cost by the local individuals and communities benefited. Such deviation, if any be necessary, to become permanent upon a two-thirds vote of the delegates of any annual convention of this association, or any special convention called for this purpose, with notice of its intent.

After being carried by the convention, the following commission was appointed:

C. W. Black, Council Grove.
A. C. Blair, Lyons.
E. W. Hoke, Marion.
Webster Ray, Delavan.
J. A. Kessler, Overbrook.

The following officers were duly elected:

President—J. M. Lowe, Kansas City, Mo.
Vice President—R. A. Long, Kansas City, Mo.
Secretary-Treasurer—Frank A. Davis, Herington.

The Executive Committee, consisting of the president and secretary, and the following men, was elected:

W. H. Mott, Herington, Kansas.
E. N. Hopkins, Lexington, Missouri.
C. E. McStay, Los Angeles, California.

The following State vice presidents were elected:

Maryland—W. E. G. Hitchins, Frostburg; Andrew J. Ramsey, Mt. Savage.

Pennsylvania—J. P. Eagleston, Washington; George F. Titlow, Uniontown.

West Virginia—H. S. Sands, Wheeling.

Ohio—Ex-Governor James M. Cox, Dayton; Jesse Taylor, Jamestown; B. A. Mathews, Columbus.

Indiana—C. A. Kenyon, Indianapolis; J. V. Ayer, Brazil; Dr. I. S. Harold, Richmond.

Illinois—C. W. Shimel, Casey; J. H. Curry, Effingham; Lincoln Bancroft, Greenup.

Missouri—Judge W. M. Williams, Boonville; Roy Britton, St. Louis.

Kansas—L. W. Silvan, Osage City; C. W. Black, Council Grove; A. C. Blair, Lyons.

Colorado—B. M. Spalding, La Junta; R. H. Higgins, Pueblo; J. F. Sherman, Trinidad.

New Mexico—R. E. Twitchell, Santa Fe; John Becker, Jr., Belen; C. N. Cotton, Gallup.

Arizona—Rev. Cyprian Vabre, Flagstaff; Anson H. Smith, Kingman; W. B. Parks, St. Johns.

California—Judge L. V. Root, Needles; Gov. J. B. Gill, San Bernardino; H. W. Keller, Los Angeles.

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## Reply to Rigid Paving

*To the Editor of "Better Roads and Streets."*

Dear Sir: The interview with Mr. A. N. Johnson, published in your issue of September, under the caption of "Rigid Paving Urged for Motor Used Streets," brings up an important subject upon which the opinions of most experts are decidedly at variance with the view expressed by Mr. Johnson. He is quoted as having said that "in selecting the type of pavement for motor traffic, there is one principle that may well be kept in mind, which is, that this class of traffic demands a rigid road surface. We can no longer successfully maintain a proper road surface with a resilient type of pavement. The resiliency must be in the vehicle and not in the pavement."

Among resilient types of street paving we must include that known as sheet asphalt. New York City has nearly two hundred thousand square yards of asphalt pavements, laid on some fifty-three streets, that have given more than twenty years' service under stress far in excess of that ever imposed upon any concrete road in the United States. In Buffalo, approximately forty per cent. of the asphalt under maintenance is more than twenty years old. Albany has 7,462 square yards of sheet asphalt, laid in 1889, which is still in good condition, having required no maintenance. Boston has more than sixty-two thousand square yards of Trinidad sheet asphalt which has given twenty years' service or better. The asphalt pavement around City Hall, in Philadelphia, was removed in 1908, at the age of twenty-four years, removal necessitated by the building of the subway. Philadelphia has other streets of like long endurance. Even the small city of Harrisburg has a million square yards of natural asphalt pavements, some of which were laid twenty-seven years ago, and are in use to-day.

The most remarkable record of durability of this type of pavement, that is to say, low maintenance, may be found in Washington, D. C. Washington has in excess of a million square yards of Trinidad sheet asphalt, the average age of which is twenty-three years. On this entire yardage the average cost per yard per year is shown by official records to be only 1.8 cents. Ninth Street, from P. Street to Florida Avenue, laid in 1879, and now thirty-five years of age, is costing but 7-10 cents per yard per year for repairs.

Even the city of Chicago, the headquarters of the Portland Cement Association, has a long list of twenty-year-old sheet asphalt pavements, representing the very minimum of outlay for maintenance.

In the city of Detroit, which has been the Mecca of concrete interests, owing to the system of concrete roads extending from that city throughout Wayne County, are sheet asphalt pavements more than twenty-three years old. They are three times as old as any concrete road in Wayne County's celebrated system of Portland cement highways. Other cities in which resilient asphalt pavements have made like records are Schenectady, Troy, Altoona, Wilkes Barre, Erie, Grand Rapids, Cleveland, Cincinnati, Columbus, Toledo, Milwaukee, St. Paul, Omaha, Indianapolis, St. Louis, Louisville, Savannah, and New Orleans.

The heaviest traffic street in the world is the Thames Embankment, London. The wearing surface of this thoroughfare consists of sheet asphalt on a very old and thick stone base. The Avenue de Paris, extending from Paris to Versailles, which is now carrying from ten to twelve hundred armored cars daily, is sheet asphalt. This road, by the way, was selected as an illustration in a recent advertisement of the Cement Association represented by Mr. Johnson, to show the value of durable thoroughfares in times of war. As a matter of fact, all of the notable and leading city streets of Europe, America, and South America have resilient wearing surfaces consisting of some form of asphaltic construction.

Investigation shows that the highest authority on concrete roads does not agree with Mr. Johnson. By this is meant the Portland Cement Association, he represents. In "Concrete Highways," published by the association, it is stated on pages 50 to 53, inclusive, that streets and highway surfaces in general constructed with asphalt as a binder, possess very many desirable qualities which are not found in many other less resilient materials. The association says that sheet asphalt pavements are extremely resistant to impact and attrition, and on this account, produce neither mud nor dust, as they do not disintegrate. Other virtues of sheet asphalt specified by the association are sanitary properties, excellent foothold for horses, minimum expenditure of energy for hauling, wearing qualities exceeding that of any other pavement under heavy travel, rapidly, easily, and economically repaired. The association says these pavements increase actual and rental value of abutting properties, and that Trinidad Lake Asphalt is the only pavement surface which has satisfactorily met the trying conditions on Victoria Embankment, London, England. Concerning bituminous concrete, the association says that its advantages are so well known as to make a repetition of same unnecessary.

The foregoing statements were published by the association in 1913, and nothing has occurred in the interim to discredit them except the assertions of its consulting engineer.

Mr. Johnson's statement that resiliency must be in the vehicle and not in the pavement, has been observed as far as possible by manufacturers of motor vehicles. They ask that it be supplemented by resiliency in the road. It was recently stated by Mr. A. L. Riker, vice president of the Locomobile Company of America, and an authority on motor car construction, that "the cushioning effect of an elastic road surface does help an automobile—and especially a motor truck operating on solid rubber tires. With such road material, the effect of small inequalities in the surface would be less felt than with a hard, non-resilient surface."

Mr. George K. Binge, president of the Pierce Arrow Motor Car Company, says that "any elasticity in the roadbed should certainly help the mechanism of a motor truck or automobile, as there would be much less vibration. This would have more influence on trucks than on pleasure cars because of the solid tires of the former."

Mr. J. G. Vincent, vice president of Engineering, Packard Motor Car Company, says that "a hard, non-resilient road, which has no elasticity, would have more tendency to cause crystallization of axles and steering parts than a slightly resilient road, providing the surfaces of both roads are equally smooth. It is, of course, true that if we could have uniform roads with a resilient top dressing that would stay smooth, we would probably be able to run all trucks a little faster without damaging the vehicle."

Daniel T. Pierce.

Philadelphia, Pa., September 16, 1916.

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## The Merits of Refined Asphalt Roads

### By Leroy M. Law, Chief Chemist, United States Asphalt Refining Company

THE subject, "The Merits of Refined Asphalt Roads," under which title I understand you intend a discussion of roads made with asphalts of petroleum origin, would scarcely have been welcomed five years ago. In fact, any discussion along such lines would, of necessity, have had to be of prospective nature, and little promising at that, for most service experiences had proven failures, and an adequate chemistry offered little grounds for optimistic predictions from the laboratory standpoint.

Moreover, prospects, predictions, and even promises do not find a very cordial reception in asphalt paving and road building for municipalities, engineers, and contractors, by reason of their responsibility to others, wisely and justly demand more definite indications of success before changing a type of material or construction.

"The Merits of Refined Asphalt Roads" quite naturally resolves itself into the merits of the asphalts used in their make-up, for, in the same type of construction, the mineral aggregates, their preparations, etc., will be practically the same for all asphalts. Let us consider, then, these changes which have been brought about in petroleum asphalts that enable one to discuss roads built from these materials, not as possibilities, but in the light of actual reality.

The evolution of any product from early types to its more protected forms is dependent upon two factors, namely, raw materials and processes of manufacture, and in every industry is it not true that there is constant endeavor to improve both of them? Is it not also true that, with our accumulation of knowledge and experience, we have entirely altered in many instances our primitive conceptions as to what were desirable materials and what were not? We have, furthermore, been for some time living in an area of conservation, and through scientific study, many valuable products have been developed from what were formerly waste materials. It is only reasonable to expect that similar impulses of progress should have characterized the petroleum asphalt industry, so let us see what changes have come about in the raw materials and processes of these asphalts to render meritorious the road construction in which they are employed.

Petroleum doubtless entered the paving industry as a "flux," or softening agency, for the solid native bitumens which were too hard to be used for paving purposes in the condition which they naturally occur. These fluxes were not straight mineral oils, but the residues or by-products of oil distillations, for in those days the major products of all refineries were the burning oils and later on gasolines and lubricants. The fluxes were, therefore, what remained in the still after these more valuable fractions had been taken out, and, under the name of "Residuum," were generally considered as containing the lubricating oils, waxes, and pitch base. That they were actually refuse products, with little or no care in regard to their quality, is shown by the fact that the oils were frequently subjected to so-called "cracking" processes for an increase over the normal yield of burning oils, etc.—this to the detriment and injury of the residuum.

There are about six more or less well-defined oil fields in this country, and in some of them the oils vary from well to well, yet all were practically distilled for the same major products. It was, therefore, not surprising that the resulting residues were variable in character and doubtless many times unsuited even for the purpose of fluxing the hard asphalts. Under such circumstances, however, petroleum asphalts originated.

The increasing use of the more successful native bitumens early became the stimulus for the development of the residuals so that they might be placed in competition with the asphalts to which they heretofore had served only as adjuncts, and, to do so, it was necessary that they be brought from their more or less fluid state to consistencies suitable for paving purposes.

While it is my intention to refer more fully later to processes and methods of treatment, it is considered best to take up at this point two innovations which were important transition stages in the development of petroleum asphalts.

It was early found that distillation of the paraffine and semi-asphaltic petroleum beyond the residuum stage resulted in the decomposition of the pitch or asphalt residues to such extent that their usefulness as paving materials could not receive serious consideration, so other means were sought to achieve the desired end. For example, it was found by Dubbs that the addition of sulphur to the residuum, maintained at elevated temperatures, resulted in a molecular condensation with liberation of sulphuretted hydrogen gas. The resulting artificial asphalts received the name of "Pittsburgh Flux," and proved to be interesting products.

Byerly, working about the same time, found, too, that by blowing air through the heated residuum the oxygen performed a similar function to the sulphur in the "Pittsburgh Flux," and in 1893 took out a patent covering the air-blowing process. This proved a most important step in the transition of petroleum asphalt, for air blowing was cheaper than sulphur, and, by regulating the duration of the "blow," asphalts varying from soft to hard consistencies could be produced. Such materials as the Hydrolines, Sarco Asphalt, Ellix Flux, etc., which were products of the blowing process, have proven indeed useful materials, although they made at no time serious inroads on the native bitumens for paving purposes. They were generally tough, rubber-like materials, low in susceptibility, but quite short, or cheesy, in character, and have served chiefly as waterproofing, block-filler materials, rubber substitutes and also to a very considerable extent as a constituent of the bituminous cements in asphalt paving blocks.

Another step in the evolution of asphalts from petroleum, was accomplished by compounding with the distillation residues such quantities of hard bitumens, like Gilsonite and Grahamite, as to produce materials of paving consistencies.

Many of these compounds contained as much oil as hard bitumen, and frequently the air-blowing process, previously referred to, was involved in their manufacture, but it is interesting to note that several other rather successful asphalts of this constitution have appeared on the market in recent years.

On account of the large percentage of the oily residuum required, however, the original element of uncertainty still prevails in regard to the finished product. This, together with the high price of Gilsonite and Grahamite and other factors, has doubtless served to greatly restrict the use of such preparations to-day.

This brings us up to about the year 1900, previous to which the oil asphalts were truly artificial materials. They were prepared at best from oils of low asphaltic contents and their solidity and consistency were proportional to the artificial means employed in their manufacture. It was, doubtless, only to be expected that they should be called by such names as manufactured asphalts, oil asphalts, residual asphalts, and the like, even though such designations are not appropriate to the totally different types that were to follow.

Asphalts from Texas and California petroleum next deserve our attention, and it is interesting to note that, while they differed widely in characteristics, both are still in use to-day, though doubtless in modified form. The original Texas asphalts, being blown, were low in susceptibility to temperature changes, but the low ductility retarded their adoption by many cities which were maintaining a minimum ductility requirement of fifteen or twenty centimeters in their specifications.

On the contrary, the California materials possessed practically unlimited ductility, for, being obtained from full asphaltic base oils, it was possible to omit the blowing process. This fact renders their advent the turning point in the evolution of petroleum asphalts, inasmuch as their preparation could be accomplished by a simple refinement direct to the desired consistency. There has, however, been some uniformity in the crude supplies and their high ratio of susceptibility has been considered objectionable in many places. Notwithstanding these features, the California materials have been quite successful and are still in use to-day.

The ideal raw material for the production of petroleum asphalts, however, became available about five years ago with the entry of Mexican petroleum into the field of raw materials. I say ideal material, for the reason that, while the asphalts produced therefrom met successfully recognized paving and road oil tests, a plentiful and uniform supply of the raw material was early assured. Mexican asphalts, it is true, had appeared in the paving industry years ago, but the early examples were but the more or less solidified effusions from the real supply, which lay thousands of feet below the surface.

In 1910, therefore, the opening of several large wells on the east coast of Mexico began a new epoch in the asphalt business, for, with the large supply and the reasonable rates of water transportation prevailing at the time, it soon became possible to place on the market excellent paving and road-building materials at prices which have made possible our great highway developments of to-day.

Two types of Mexican petroleum constitute, in general, the supply of crude material brought into this country—a heavy, crude oil of ten to twelve degrees, Baume, gravity, carrying about seventy per cent. of asphalt, and a lighter one of eighteen to twenty degrees gravity with an asphalt content of fifty-five to sixty per cent. These issue from wells of from three thousand to five thousand feet depth, are collected in large storage tanks or sometimes in earthen ponds or lakes, and then are pumped into specially-constructed tank ships ranging from thirty to sixty thousand barrels in capacity for transportation to the refineries of this country.

Both oils yield excellent paving materials, their high asphalt contents and correspondingly low percentages of light oils enable their refinement to be accomplished promptly and with a minimum risk of injuring the asphalt residues, which, in the handling of Mexican petroleums, are the major products of the refinery.

With both types of crude, furthermore, it is commercially practicable to stop the refining or reduction process at any stage of consistency between the fluidity of the natural liquid and the solidity of the hardest paving cement, so as to give the engineer a material made by one simple process to the consistency he desires. By such procedure, the natural fluxes are retained and he is relieved of subsequent artificial fluxing with its attendant losses in time, to say nothing as to the uncertainty involved by using softening agencies of unknown character.

For paving cements and road binders, there is apparently a preference for products of the heavier oils, doubtless on account of their greater density and lower paraffine content, but the lighter oils, however, serve as the chief source for road surfacing materials. When simply freed from moisture and sediment, they serve as a cold surface dressing for macadam roads, the naturally occurring gasoline which they carry serving as a natural thinner to facilitate penetration into the road structure. Deprived of these lighter oils to greater or less extent, they serve in excellent manner for the more permanent and so-called hot surface applications.

That the merits predicted for the materials by scientific tests have been verified is evidenced by their almost general use to-day. Boston, Providence, Worcester, Springfield, New Bedford, Hartford, Holyoke, New York City, Philadelphia, Baltimore, Washington, Cleveland, Detroit, Chicago, Pittsburgh, and many other cities too numerous to mention, use large yardage of Mexican sheet asphalt and asphaltic concrete, types of construction demanding the highest requisites. In many of these cities, too, pavements have successfully passed into their fifth year of service—an accomplishment not in any way a measure of their life or usefulness, but one that should convince those engineers who place small reliance in laboratory tests.

As to road constructions and treatments, the uses of Mexican products have been even more general than in street pavements, and I need only refer to the extensive and successful cold applications in the Maryland State Highway System during the past two or three years, and to the binder construction of Massachusetts, New York, New Jersey, Pennsylvania, Illinois, Maine, Virginia, New Hampshire, and the Provinces of Canada.

Such recognition of asphalts from Mexican petroleum show that the early conceptions of "oil asphalts" are fast being obliterated. Certainly they indicate that the character of the material itself is to be primarily considered rather than a mere classification in which that material may be placed. In this connection, let me call your attention to the decision of the Supreme Court of the State of New York to the effect that asphalts prepared from Mexican petroleum are to be considered in every respect natural asphalts.

We have reviewed somewhat rapidly the evolution of petroleum asphalts, particularly as regards raw materials, but touching to some extent, upon the processes of manufacture. Let us now consider these factors further.

It has been stated that petroleum asphalts doubtless originated with the haphazard residues from the ordinary distillation of paraffine and semi-asphaltic oils, and it has been explained how these distillations were conducted solely for the more valuable burning oils with little or no regard for the "residuum." It has also been stated that attempts to bring these products to harder consistencies have gradually developed products interesting and useful, but still of limited success as paving materials.

With the entry of California materials, however, it was noted that it became possible to simplify the process of preparing the petroleum asphalts. This was due to the character of the oils themselves for they were rather to be considered as fluid asphalts than mere oils, as commonly and previously understood.

A high asphalt content with a corresponding reduction in the amount of burning oils resulted in a complete change of purpose, and what was "residuum," or residue, became the major product. This is the practice to-day in the refinement of the Mexican petroleums wherein every possible care is taken to conserve the asphalt constituents, leaving as the refuse or by-products, the unnecessary volatile oils, which are sold for fuel and gas-making purposes.

This radical change in petroleum refinement has brought forth several new processes, among which may be mentioned those covered by the Dundas and the Trumbull patents. Both are of California origin, the former little used, but the latter in successful operation with both California and Mexican oils, and worthy of mention.

Its operation depends upon pre-heating the oil and then pumping it to the top of heat-jacketed, cylindrical towers, down the inner surface of which it is allowed to flow in a thin sheet or stream. Around a central vertical standpipe or "off-take" are openings for the vapors or light oils to pass on their way to the condensers. These openings are protected by conical or umbrella-like shields, so that they will not be clogged by the asphalt as it passes on its way to the bottom of the tower. The temperature employed and the rate of pumping determine the consistency of the asphalt.

The most generally used process, however, is that of steam distillation—old in practice, but well founded in theory—which removed the lighter oils from the associated materials at a temperature below their normal boiling points.

In this procedure the petroleum, after the removal of moisture by settling or by other suitable treatment, is charged into stills, frequently as large as 1,000 or 1,200 barrels capacity. Heat is slowly applied and maintained throughout the run, but the distillation is actually accomplished by steam vapors. A current of live steam is, therefore, passed into the heated oil, and, issuing from a multitude of fine orifices along the still bottom, carries the light oils with it and the mixed vapors pass to the condensers.

While these oils would require temperatures as high as 900 or 1,000 degrees Fahrenheit for their actual distillation, this steaming process enables them to be removed as low as 600 to 650 degrees Fahrenheit, for in the best-regulated plants the asphalt in the still is never allowed to exceed such temperatures. Agitation due to the passage of the steam further assists in the work by preventing long contact of any portion of the asphalt with the still bottom, where the heat is necessarily greatest.

In the best-regulated plants, recording pyrometers indicate the actual temperature at all times, and when careful tests show that the desired consistency has been reached, the charge is allowed to cool, after which it is then pumped to storage or drummed for shipment.

Thus, with processes, as with materials, there has been a great change from the practice of former days.

Following the path of its predecessors, it was perhaps to be expected that the higher types of petroleum asphalt, as represented by the Mexican products, would encounter suspicion, doubt, and opposition on entering the field of competition. There had been, however, a parallel advance in the science of testing bituminous materials, and it was anticipated that this would go far toward assuring reliability. It did to a very large extent, otherwise petroleum asphalts would not have attained their present high standing, but there were many obstacles left to be overcome.

Specifications were frequently deliberately closed to them by discriminative titles and analytical requirements otherwise of little value, and in many cases there was coupled on a requisite as to previous service. Had this same practice been applied to other lines of manufacture, our industrial development could have been but a dwarf to its present growth, for many of our more useful materials would still be considered as only scientific curiosities.

Thanks to the chemist, however, these conditions have become largely eliminated for to-day in all well-posted communities, the best types of petroleum asphalt are welcomed in open competition with all other good materials.

Thanks also to those engineers whose early confidence enabled these products to begin a career of usefulness so that we have now tangible evidence of their reliability.

Thanks to both of them for the present road systems, the filling out of whose skeletons have been largely the result of competition induced by Mexican asphalts—a fitting tribute to the merits of roads made from refined petroleum asphalts.




UNCLE SAM: "ADOPT HIM, I'LL PAY HALF THE EXPENSE."

# County Road Construction and Maintenance

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This article is an abstract of a talk given by Mr. Dayton, County Superintendent of Highways of Cayuga County, New York, at the meeting of the New York State Association of County Highway Superintendents, Syracuse, Sept. 14, 1916.

I am a crank on the subject of good roads, and in this I feel at home because I believe there are others of the same kind here. I firmly believe that good roads pay, and that they are a profitable investment for the farmer, the merchant, the business man, the pleasure rider, and the taxpayer.

Believing this, I want to get all I can and have the money stretch just as far as it will in my county. On January 1, 1916, including one road that was under construction, we had 101 miles of State road and State-built county highways in Cayuga County. We were glad to get the State-built roads, and we would like to have more of them, but even if the whole State legislative map of 1907 is completed in Cayuga County, we would only have one-tenth of the 1,497 miles of road in the county, and our people want more than that.

In the effort to give them what they want, Section 320 A was evolved and put on the statute books. Section 320 was already in the Highway Law, but it limited roads built to letting by contract, while 320 A permits work being done by force account. Contract work, of necessity, requires engineering and surveying, the measuring of quantities as a basis for paying for the work, blue prints, advertising, inspection, and careful watching to see that the contractor lives up to the contract, and an allowance for profit for the contractor, and for moving his plant.

Force account work, however, under the charge of the town highway superintendent, eliminates most of the measuring of quantities and of inspection, although some inspection and comparison of costs is necessary. Although I know of instances where force account work has failed, and one instance where political debts were paid by placing political sinecures on the work, in spite of this I believe that force account work pays and that it gets practically all the money into the road. For after all, in spite of all we hear about organization and efficiency, two words worked to death; but it is the personal equation that counts, and it is also the man in charge that counts.

Under Section 320A of the Highway Laws of New York State, the man directly in charge of the work is the town highway superintendent. He is a man chosen and elected by his neighbors who know him well, to spend their money. He sometimes comes to us without any real road-building experiences, but he is a chosen man, and nine times out of ten he will learn, and learn very quickly.

We have been having town superintendent's meetings every month during the winter months, and the best results that have been obtained from these meetings are not from any formal talks or lectures, but in getting these town superintendents arguing among themselves about road building and maintenance methods, and their different experiences.

I have made the statement in my county that I could pick eight or ten men from my twenty-three town superintendents that in organization methods are handling their laborers and getting results that will compare most favorably with those of the foremen employed by the average contractor on road work in this State. I have received the answer that they could not handle a gang of Italians, but we do not have to, and that brings me to the next point, which is the important one of the labor for work on the roads.

Wages have been very high this summer and laborers have been very scarce. Our contractors in Cayuga County have been paying $2.50 per day, not because they have wanted to, but because they have had to. But we have had twenty stone road jobs going on this summer by force account in my county, and excepting in one case, local men have been employed on the work with a standard wage of two dollars, occasionally raising this for certain men to $2.25 and $2.50. There are lots of natives of our towns who would rather work for two dollars a day among their own people and friends than take a number and work among the Italians for a contractor at $2.50 per day. Many of these people are taxpayers.

Getting back to the county system of roads, I will explain what we have been doing in Cayuga County, and how we have done it. First, the plan for the system was worked out and then the type of construction for the roads to be improved was selected. The map adopted by the Board of Supervisors, covering the roads which were to constitute the county system, included a total of 128 miles of highways and was planned for five years ahead. These roads, as adopted, were planned to supplement, and not to rival, the portions of the State system of highways which were within the county. As an instance, south from Auburn, two State roads are planned and have been partially built. Three railroads are on each side of and between the two State roads. The county map added an extension of one other State road on the extreme eastern boundary of the county, and three cross roads connecting with the State roads and passing the railroad stations. One of these roads was ten miles, another was fourteen miles, and the third was twenty miles in length, thereby affording a good, improved road in all directions from the main roads to the railroad stations and the creamery. Therefore, the farmer can haul his produce at all times of the year over good roads, and this plan had the interests of the farmers more in mind than the construction of roads for the automobile touring through the country.

We pay for our county roads as we build them. The State is giving us its share under the State-aid Act, and the county and towns pay the balance. This money is raised by a tax of $1.50 per one thousand dollars of assessed valuation, as we figured from the start that the people of our county wanted improved roads badly enough to pay this road tax in addition to the other road taxes. When this money is expended, we will stop our road construction. Cayuga county, in assessed valuation, is the average county of the State.

There are fifteen roads leading out of Auburn, our central city. These roads run in all directions, and you cannot get out of Auburn excepting over an improved road. Seven of these exits are State roads, six are in our county road system, and the remaining two are stone roads.

We built seventeen miles of road for our county system in 1914, eighteen miles in 1915, and will have completed more than twenty miles at the close of our construction season this year. As to the types of roads which we are building, our plan is uniform in all towns. We build water-bound macadam, twelve feet in width, with wide shoulders. This is the same type of road that was built by the State eight and ten years ago when I was a contractor building roads for the State Highway Department. Since that time, however, the State has gone over, up until last year, to bituminous and other types, but the State is again coming back to the water-bound macadam road. Of the 1,073 miles of road placed under contract last year, 381 miles were water-bound macadam and 176 miles were water-bound macadam with a surface treatment, a total of more than fifty per cent. of the total mileage awarded. There were also 349 miles, or 32 per cent. of bituminous macadam construction, while the balance, 167 miles, was of concrete, brick, and miscellaneous types. New York State is building some very good roads and we have learned and profited a great deal by the department's experience.

We plan to build our roads as inexpensively as possible, and for this reason we make use of local stone wherever possible. We have used sandstone, limestone, and mixed glacial drift stone. Cayuga County, which is seventy-five miles long from north to south, has eleven geological formations ranging from the sandstones of the Siluric Age to the hatch flags of the Devonic Age. Where we use sandstone or field stone of glacial drift origin, we learned after the first year to buy and supplement with commercial limestone dust and screenings the local stone dust. It not only adds greatly to the appearance of the road, but adds also greatly to its value and its permanence through furnishing an excellent binder.

There are only three or four towns in our county that have no stone suitable for road building, or in insufficient quantity to use for this purpose. For these towns we buy commercial stone, but the cost runs somewhat higher than where the towns have their stone.

We have no unbending rule regarding grading, excepting that we do not permit the laying of stone on any grades over ten per cent. Quite frequently, however, we grade much lower

where conditions especially favor it, such as taking the top off a knoll, and having the road rise up evenly from both sides. As a rule the old, traveled road which has had more or less gravel spread on it, year after year, for years, and even the road that is crust-hardened by travel, affords a foundation that is too valuable to be sacrificed for a little minor grading. We therefore use the old roadbed as much as possible. I have frequently put a "U" in a road when I could have built it in almost a straight line, as I preferred doing this rather than getting off the old road bed. Almost always the road we are improving needs widening, and this is done on one side or the other in such a manner that we obtain the straightest possible road.

In staking out a road it is only occasionally that I make use of the transit in order to get a straight line. Generally I stake the center of the road and use the stakes as ranging pins and then drive eighteen-foot offsets, six feet from the proposed center of the road to the edge of the macadam, the next six feet farther out to the edge of the proposed ditch line, and the third six feet farther out of the way for safety. I only run the levels where it is a question of grading, when elevations and profile are very handy to show where the cut and fill will meet.

We shape the road and throw up the shoulders principally with the roller and grader. According to the conditions on the road we are working, we pull the earth from the ditch line for the shoulder or we shape up the road and push the dirt out away from the center of the road to form the shoulders. Generally on high spots we bury the road by pushing the dirt out, while on low spots we bring it in from the sides. Where the old roadbed already has a good crown, we bring the earth in from the ditches for the shoulders. We try to start with a crown on the sub-grade, but it is hard to keep it this way.

On this sub-grade we lay five inches of stone ranging from three inches up and including the tailings. We use blocks set on the sub-grade to measure the thickness of the stone placed, although we frequently average it and fill up all inequalities in the sub-grade with this layer of stone. The town superintendent always wants a road he is building to do him credit, and contrary to the rule that generally holds where the work is being done under contract, the quantity of stone that is put in the road nearly always exceeds the estimated required amount. Last year's records showed eleven towns that ran twenty per cent. above the requirements, and in one case it ran up to nearly forty per cent. more than required. But in such cases the stone is in the roads and will not hurt them any. We roll this stone until it is well compacted, beginning with the hind wheel of the roller about four inches overlapping the shoulder for the first round. Then we fill it in with worn road earth, if the latter is sandy or otherwise suitable, or with fine gravel or sand, which is hauled in if there is no suitable material to be found along the road. Sometimes for this purpose we use a part of the stone dust. It is then rolled again until when the load of top stone is hauled over this rolled course it will leave nothing more than a mere surface mark. The strength of the road is in that bottom course, and the top course is nothing more than the wearing surface. After the top course has been placed, this course being three inches in thickness, it is filled, generally with limestone dust or fine screenings that are hauled in, it is thoroughly puddled, and the shoulders are built up for three or four inches.

We seldom bother with this puddling until the stone is laid unless we get a rain. But we get the top course filled with the dust and screenings and well rolled and ready for water. Then if a good rain comes, it frequently saves us hundreds of dollars. The steam roller man is a full-time man and he is busiest when it is raining. While the broom rigging behind and attached to the roller works well, a good man or two with rattan brooms working on the spots, is better. We frequently haul water to supplement the rain and to help to puddle after the rain has stopped, and when the rain has put a stop to laying and crushing stone.

Eighteen of the towns in our county now own stone crushing outfits, and there are also eighteen towns in the county which own steam road rollers, although these towns are not in all cases the same ones which own the crushing outfits. There are also a number of towns which own traction engines for power grading and for operating the crushers, and seven towns own steam drills. All towns in the county own dump wagons, or dump boxes, or both.

The screen sizes in our crushing outfits have been and still are undergoing a change. I was once of the opinion that for general town use, especially where the stone was placed on the road and not compacted by the roller, as was once the custom, one-inch, two-inch, and three-inch stone and tailings made a complete assortment of bin sizes. We have changed these sizes now, however, and now use one-half inch, one and one-quarter inch, two and one-quarter inch, three and one-half inch stone and the tailings. We mix the tailings in with the No. 4 stone for our bottom course work. The stone from one-half inch to one and one-quarter inch we take out and store away for use for other purposes. When we have an excess of this stone we sometimes use it for filling in holes prior to the placing of the bottom course stone, but I believe that that stone has no proper place in the construction of water-bound macadam roads. If it is put in the top course, it is hard to properly puddle the road, and after it has been used a short time, the road will start to ravel badly. The stone is not sufficiently large to bind properly, but it is an excellent material for maintenance work.

This brings us up to a most important step. The building of a road is but one step of the work. Even during the construction of a road, we are planning for its preservation and maintenance. No road, at whatever cost, is a permanent road, and this applies least of all to the water-bound macadam road, which is an excellent road at all times, provided it has the proper attention. It does not pay to let the macadam road go bad, however, as it will cost too much to repair it.

We have taken the stand in Cayuga County that we do not want to oil any newly-constructed macadam road until the road has had time to "find itself," and to develop whatever weaknesses there may happen to be. Generally there will be some weak spots in the best-constructed macadam road. There will be some settlement, or there may be some holes or depressions appear, the latter generally being due to faults in the sub-grade. We did not do any oiling of our roads in 1914 or in 1915, but have done some this year. We mixed the oil with stone and sand and filled all depressions in the roads that have already been improved with this material. Generally, however, we used too much oil, as these patches were often too soft. After this material had been placed in the depressions, the patch was thoroughly compacted with the roller, after which it was covered with a coat of Tarvia B.

We considered various cold applications, and bought thirty-three thousand gallons of Tarvia for surface treatment. Our contract with the Barrett Company called for this material to be delivered and applied on the road. The Barrett Company used an auto distributor and the Tarvia was applied nine feet in width through the center of the twelve-foot road, as we did not consider that the edge of the road needed this surface treatment. The distributor was able to cover this nine feet of width on one round of the machine. We obtained the best results when we followed the distributor closely with the small stone.

I am trying to get our Board of Supervisors to buy a power distributor next year, and if we get one, I am going to have the work so arranged that the stone spreaders will be able to work up close to the distributor, and that at no time will the oil remain uncovered more than ten minutes. We attempted to spread one section this year with the stone first and then covered with the tar, but we found that the same quantity that got good results on our other roads was not enough to afford a union of the loose stone with the macadam, and we had to give this road an additional coat of Tarvia, which made a good job of it.

We departed somewhat from our usual rules for surface application this year in two particulars. We broke away from the New York rule on account of reports of results in Ohio and from the United States Office of Public Roads and Rural Engineering. First, we used a larger stone for our blotter, using the maintenance stone saved from the stone crushed for construction. This stone was rejected by the one-half-inch screen, but passed the one-and-one-quarter-inch screen. Where we had not saved any of this stone, we purchased it from the commercial quarries. Second, we firmed the stone down upon the macadam by using the road roller, which crushed some of the stone to average small sizes. This method used this year

has been so successful that we are going to apply our surface treatments in the same way next year.

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## Fox Report Advocates a Business Basis for the Department of Street Cleaning of New York City

IT is fairly certain that any private corporation engaged in work involving the regular employment of seven thousand men and the expenditure of nine million dollars annually, would, first of all, decide upon a definite policy of administration for its business, then select as general manager a man qualified by past experience to produce results, and, finally, to keep this executive in office as long as he continued to make good. The Department of Street Cleaning of New York City is an organization whose activities are on precisely the scale outlined above. Yet during the last seventeen years its administrative control has changed, on an average, once every two years, while in the four-year term of one mayor, there were five street-cleaning commissioners. The most astonishing fact, from a business standpoint of view is, that of all the commissioners who have held the office since the department was created in 1881, only one, the present commissioner, John T. Fetherston, had had any previous experience in conducting street-cleaning operations. These and other important facts are cited in a report on New York street-cleaning methods and personnel, which Richard T. Fox has submitted to Commissioner Fetherston, to indicate why so few improvements in personnel, methods of work or equipment have been made during almost a score of years, in spite of the fact that the department's employees have the highest rate of pay and the best working conditions, as to vacations, sick time, and pensions, of any labor of this class in the United States. What New York needs most, Mr. Fox finds, is a continuous street-cleaning policy, and this will be possible only when the commissionership is regarded as a job demanding expert qualifications and long tenure of office, rather than as a means for the payment of political debts. The taxpayers of New York City, who are saddled with the burden of the city's huge bill for street cleaning and snow removal, will do well to give Mr. Fox's recommendation more than passing notice. It will mean money in their pockets.

Regarding the methods of work, Mr. Fox makes a number of conservative criticisms, which are applicable to street cleaning in other cities as well as in New York City. Under present conditions of affairs, the cleaning and flushing of the sidewalks is no person's business. Mr. Fox recommends the placing of this work under the control of the Department of Street Cleaning. Few cities in the United States, it is believed, follow this practice.

One of the department's most pressing needs is improved and up-to-date street-cleaning equipment. To-day there are available many improved mechanical devices, but no funds have been provided for their purchase, and, with a few exceptions, the methods of the work and the equipment are the same as were used in Colonel Waring's time, seventeen years ago. Contractors in private practice have not been slow to avail themselves of the many labor-saving devices which manufacturers have developed in the field of general engineering construction. They realize that investment in a first-class plant eventually results in increased profits, but in the case of the work of the Department of Street Cleaning, of New York City the municipal purse strings apparently have been tightened regularly at any suggestion of purchases of improved equipment.

In his report, Mr. Fox states that need is found for a system by which the accountability of men and machines may fairly be fixed and by which comparisons of costs may be made. Another of his suggestions is that a school of instruction for both officers and men, dealing with the best methods of work and the best use of equipment, be encouraged. This is highly desirable, and it could be organized somewhat on the lines of non-commissioned officers' schools in military organizations.

This report shows that there are several obstacles in the way of the highest efficiency in the department and the recommendation is made that the plan of establishing a model street-cleaning district in Manhattan be carried out. This model district would serve as an object lesson on street-cleaning methods and results upon which to base extensions of the system throughout the city, as well as to serve as a ground for experiments in new machinery and methods.

In his report, Mr. Fox also shows the close connection, with but one or two exceptions, with the political machinery of the city, and the consequent comparative inefficiency of many of its seven thousand employees.

Mr. Fox was for seven years prior to 1902 connected with the New York Department in various capacities, and has for some years been in executive charge of the Citizens' Street Cleaning Bureau of Chicago.

The following is a summary of his recommendations, regarding which more will be published later in subsequent issues of Better Roads and Streets.

### THE FOX RECOMMENDATIONS AFFECTING THE INSTALLATION OF THE MODEL STREET-CLEANING DISTRICT IN NEW YORK CITY.

1. That hand cleaning only be employed, supplemented by flushing or washing with water under pressure.
2. That the intensive method of street cleaning be adopted.
3. That the value of inspection cannot be over-emphasized in any attempt to maintain high standards of street cleaning, and therefore the supervisory force be composed of A No. 1 men, intelligent, industrious, and observing. That the laborers employed be alert and active, and capable of maintaining the standards of work set.
4. That leggins be added to the uniform now used, to protect the trousers, and to add completeness to the equipment.
5. An order requiring the men to polish their shoes daily is of great value in impressing the importance of neatness and attention to detail in their daily street-cleaning tasks.
6. That the sidewalks be included with the roadway, and the street cleaned from house line to house line.
7. That the street-cleaning implements consist of a broom and a shovel for cleaning rough pavements, and a broom and a scraper for cleaning smooth pavements. The broom to be made of sufficiently fine material to insure thorough work.
8. The implements used in cleaning the sidewalks to consist of a pan and a horse-hair or other fine broom.
9. That boxes with hinged tops and of sufficient capacity to care for the entire day's output of street dirt, be placed at convenient intervals on the sidewalk, or preferably, sunk in the sidewalk, for the temporary storage of the dirt as collected by the street sweeper, and that, for esthetic as well as economic reasons, the street sweepings be collected at night only.

The street dirt is then out of sight and is protected from scattering by traffic and the wind. The sweeper can work more rapidly than with the two-wheel cart receptacle.

10. That the roadways be flushed nightly with motor-driven machines, carrying tanks, from which the water is forced out under the necessary pressure to obtain efficient washing of the streets. That the sidewalks be washed by machine, and hand-squeegeed nightly, or as often as necessary.
11. That a sufficient number of street sweepers be employed after four o'clock, the quitting time of the day force, to pick up the heavy dirt preparatory to flushing the streets, and thus prevent frequent filling of the catch basins, and possible obstruction of the sewers. The adoption of this plan will mean clean streets practically through the twenty-fours hours.

The men required for this service can be estimated roughly as one-tenth of the number employed for cleaning during the day.

12. That the streets be lightly sprinkled through the day, as often as necessary. The sprinkling should be confined to the gutters, and the space four or five feet therefrom, for the tendency of traffic and the slope of the street is to force the dust to the gutter. On streets carrying car tracks, the right-of-way, which collects considerable dust, should also be lightly sprinkled.
13. That when the temperature does not permit of sprinkling, the men sweeping the sidewalks be required to remove any noticeable collections of dust in the roadways. A vacuum cleaner, if it can be made practicable for this purpose, would serve a valuable end.
14. That the functions of sprinkling, flushing, and removal of street sweepings be co-ordinated, if possible, with the collection of waste to obtain the greatest economy in the oper-

ation of the power-driven equipment now being installed for the latter purpose.

15. That checks on the density of traffic, changes in pavement, the amount of refuse collected by each sweeper, etc., be made from time to time and followed by such readjustment of the route areas as are found necessary. Also that checks be made at regular intervals to determine if the set standards of cleanliness are being maintained.

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## Cost of State Aid Roads in Michigan

INVESTIGATION reveals a startling increase in the cost of roads constructed under the supervision of the Michigan State Highway Department during the past ten years. This increase may be charged to (a) the increased cost of labor and to (b) better specifications, which raise the requirements for materials and call for better methods of construction. The latter change was made necessary by the increasing demands of the traffic, and, while the cost of construction has been thereby increased, better roads are being built now than formerly. The lack of reliable data relating to the traffic on early roads prevents a comparison of the present and former types on the basis of the ratio of the traffic carried to the cost, and it is doubtful whether such a comparison would be of value, due to the large proportion of automobile traffic. It is safe to say, however, that the roads of recent construction, although built at an increased cost, are carrying the traffic imposed upon them at a reduced cost per vehicle mile.

The Michigan State Highway Department was created in 1905. A law extending State aid to road construction, with subsequent amendments, provides for the payment of rewards varying from $2,500 to $3,400 per mile on seven different types of roads. Specifications were adopted to cover the several classes, which have been improved from time to time. Conforming to these specifications, a large mileage of gravel and macadam roads has been constructed in the State. A study of the costs of these roads, both past and present, brings to light some interesting results.

The gravel road has always been a popular type of construction, due to the fact that large deposits of gravel, suitable for road metal, exist throughout the State, the utilization of which, in sections where the volume of the traffic is not beyond the capacity of the road, is in accordance with good engineering practice. Too, the construction of gravel roads involves largely the problem of laber, and the money spent is kept in the locality where the taxes are assessed. During the early existence of the department, both the gravel and labor could be obtained at exceedingly low prices. In 1905, the gravel used cost on an average, twelve cents per cubic yard. The early records show a cost of $1.75 to $2.00 per day for laborers, and $3.00 a day for team hire. The average cost of a nine-foot gravel road was fifteen hundred dollars per mile.

Until the use of the automobile became so extensive as to affect seriously the cost of maintenance, macadam roads carried a large share of the heavy traffic throughout the world. It was natural, therefore, that macadam should enter into the early scheme of road building in this State to a large extent. As a matter of fact, macadam roads constitute no small proportion of the mileage constructed at the present time, and, with a bituminous surface treatment, they have been found to be an excellent intermediary between gravel and the higher types, such as concrete and brick. The cost of constructing macadam roads has not increased as greatly as that of gravel, and still forms a relatively economical type to build. The cost of stone for macadam roads in 1905 varied through quite a wide range, but the average was about $1.30 per cubic yard, which is not widely different from the present cost. An average of fifty-seven miles of macadam road constructed during the years 1905 and 1906 shows the cost per mile to be $3,100.

For the purpose of showing in detail the distribution of the cost for gravel and macadam roads at the present time, as well as arriving at a representative average cost per mile, tables I. and II. presented herewith, have been prepared. There is a wide diversity of construction methods and plant used, with a great range of conditions from suburban streets to roads through uncut forests. For this reason, fifty-nine jobs, aggregating 68.42 miles of nine-foot gravel roads, having an eight-inch depth of gravel, three or more of which have the same average haul, are combined under each classification of average haul in Table I. The roads used in compiling Table I. lie in twelve of the agricultural counties of central and southern Michigan. They are representative of average conditions and methods of construction possible in any agricultural community. A like classification is shown in Table II. for a macadam road having a six-inch depth of stone and a nine-foot width of roadway. For this table, fifty-three jobs, aggregating 52.33 miles of road, located in six counties in the same district as the gravel roads of Table I., were combined.

It will be noted from Tables I. and II. that the average cost of gravel roads has risen to $2,400, and that of macadam roads to $4,400, an increase of sixty per cent. and forty-two per cent. respectively. Truly the high cost of living has affected the cost of road building. The cost of labor now varies from $2.25 to $3.00 per day, with an average cost of $2.50. The cost of teams has advanced enormously, frequently being as high as six dollars per day. The cost of gravel has practically doubled, being about thirty cents per cubic yard at the pit. That the increase in cost of macadam construction has not been proportionately as great as that of gravel, may be attributed to the fact that the cost of stone is but little greater—$1.50 per cubic yard on the average.

The maximum width of road which it is permissible to reward under the State-aid Law is sixteen feet. Costs recently compiled for sixteen-foot gravel and macadam roads give the average cost per mile of the former at $4,400, and the range of cost from $2,300 to $9,000 per mile. The average cost per mile of sixteen-foot macadam is shown to be $7,500, with a range of from $4,200 to $11,000 per mile.

It is not within the province of this article to relate in detail the changes and improvements in the constructional methods which have taken place during the life of the department to which a large portion of the increased cost of building the roads is chargeable. A few of the important features will be emphasized here, however, in order to compare the old and new types and to show the class of roads now being constructed under the supervision of the department. The grading and drainage requirements for all types of roads have been greatly amplified. The original specifications for gravel roads provided that sixty per cent. of the gravel by weight should be pebbles above one-eighth inch in size, with no pebbles in the bottom layer that would not pass through a two-and-one-half-inch screen, and in the top layer that would not pass through a one-and-one-half-inch screen, and permitted forty per cent. of binding material in the form of clay or pulverized limestone. The present specifications encourage the use of gravel in the top course, seventy-five per cent. of which will pass a one-and-one-half-inch screen, with only enough clay present to coat the pebbles (not more than ten per cent.), and no free lumps. The presence of limestone in such a form and quantity as to coat the pebbles and cement them together is very desirable. In the case of macadam construction, the depth of metal has been increased from a uniform depth of six inches to a depth of seven inches at the center, and six inches at the edges for roads from nine to twelve feet in width, and to eight inches at the center and seven inches at the edges for roads from thirteen to sixteen feet in width.

The five classes of roads provided for in the first State Reward Road Law, were gravel and macadam, and combinations of these two types. Lowest in cost and also in point of service is what is known as the Class A Road, which includes sand-clay and low-test gravel surfaces. The average cost of a nine-foot Class A Road is seventeen hundred dollars per mile. While it is not desirable to build this type when gravel can be secured, the low cost has enabled certain sparsely-settled localities where the traffic is light, to make passable certain roads which otherwise could not have been improved. Classes C. and D. are respectively stone-gravel or slag, and gravel or slag-stone types. The former possesses a solid stone foundation and a gravel, or slag, wearing surface. The gravel seems to withstand well the action of the automobile traffic, while crushed slag, if used for the top course, because of its porous nature, lends itself readily to bituminous treatment. Class D. consists of a low-cost gravel or slag foundation with a top course of macadam. The records show an average cost of $3,800 per mile for Class C. and $3,250 per mile for Class D., both values being taken for roads of nine-foot width.

The law has been amended so as to include concrete and brick surfaces which are entitled to rewards as high as thirty-four hundred dollars per mile, when constructed according to the State specifications. It is interesting to note that the first mile of road ever built was rewarded by the department in June, 1909. Although Wayne County has become famous for its concrete roads, comparatively few counties of the State are able to build concrete roads, the cost averaging slightly over one thousand dollars per mile per foot of width. Relatively little mileage of brick has been constructed.

TABLE I. DISTRIBUTION OF COST OF GRAVEL ROADS ACCORDING TO THE LENGTH OF HAUL (Width 9 feet).

| Average haul (miles) | Length of road (miles) | Ditches and grade | Surfacing | Gravel | Bridges and Culverts | Yards of gravel used (loose meas.) | Total Cost |
|---|---|---|---|---|---|---|---|
| 0.250 | 1.77 | $ 1,613.21 | $ 1,635.21 | $ 296.00 | $ 599.60 | 2,370 | $ 4,144.02 |
| 0.500 | 3.36 | 990.00 | 3,302.35 | 499.27 | 267.00 | 5,050 | 5,058.62 |
| 0.750 | 5.79 | 2,044.02 | 5,817.14 | 1,033.25 | 972.00 | 9,758 | 9,866.41 |
| 1.000 | 5.25 | 3,485.00 | 7,340.22 | 4,648.33 | 503.00 | 8,865 | 15,976.55 |
| 1.250 | 3.00 | 1,161.36 | 3,567.11 | 498.00 | 275.05 | 5,020 | 5,501.52 |
| 1.500 | 5.17 | 1,896.00 | 7,492.26 | 807.45 | 294.80 | 8,125 | 10,490.51 |
| 1.750 | 4.39 | 2,177.08 | 8,465.73 | 680.60 | 134.56 | 7,539 | 11,457.97 |
| 2.000 | 5.59 | 2,656.07 | 9,070.53 | 919.85 | 764.88 | 9,269 | 13,411.33 |
| 2.500 | 5.98 | 3,246.32 | 10,054.71 | 1,033.85 | 266.56 | 10,580 | 14,601.44 |
| 3.000 | 11.54 | 4,093.22 | 21,449.93 | 2,606.30 | 616.49 | 17,895 | 28,765.94 |
| 3.500 | 4.75 | 2,199.18 | 10,601.53 | 973.50 | 88.50 | 8,231 | 13,862.71 |
| 4.000 | 4.97 | 1,861.25 | 11,191.95 | 1,481.00 | ..... | 8,411 | 14,534.20 |
| 4.500 | 2.08 | 1,005.81 | 3,754.49 | 651.38 | 31.33 | 3,418 | 5,443.01 |
| 5.000 | 4.78 | 2,050.90 | 10,644.19 | 795.52 | 111.50 | 8,342 | 13,602.11 |
| | 68.42 | $30,479.42 | $114,387.35 | $16,924.30 | $4,925.27 | 112,873 | $166,716.34 |
| Average per mile | | $455.46 | | $247.34 | | 1,649 | $2,436.58 |

TABLE II. DISTRIBUTION OF COST OF MACADAM ROADS ACCORDING TO THE LENGTH OF HAUL (Width 9 feet).

| Average haul (miles) | Length of road (miles) | Ditches and grade | Surfacing | Stone | Bridges and Culverts | Yards of stone used (loose meas.) | Total Cost |
|---|---|---|---|---|---|---|---|
| 0.250 | 3.04 | $ 1,439.71 | $ 3,372.60 | $ 6,072.49 | $ 473.09 | 4,955 | $ 11,357.89 |
| 0.500 | 2.55 | 968.62 | 2,539.00 | 4,063.25 | 43.90 | 3,524 | 7,614.77 |
| 0.750 | 4.32 | 1,735.40 | 5,671.33 | 6,719.74 | 143.60 | 7,023 | 14,270.07 |
| 1.000 | 3.73 | 1,237.00 | 3,659.60 | 7,318.21 | 136.47 | 5,647 | 12,351.28 |
| 1.250 | 4.12 | 2,263.01 | 4,932.82 | 9,462.71 | 434.20 | 7,283 | 17,092.74 |
| 1.500 | 4.06 | 1,665.03 | 5,526.10 | 10,115.93 | 240.34 | 8,127 | 17,547.40 |
| 1.750 | 5.41 | 3,158.55 | 8,138.70 | 13,196.16 | 623.35 | 9,212 | 25,116.76 |
| 2.000 | 4.48 | 2,075.60 | 8,017.33 | 12,924.72 | 282.42 | 7,790 | 23,300.07 |
| 2.500 | 4.72 | 2,115.39 | 8,410.08 | 12,310.87 | 45.00 | 7,955 | 22,881.34 |
| 3.000 | 3.58 | 1,841.52 | 6,211.33 | 7,194.03 | 350.75 | 5,670 | 15,597.63 |
| 3.500 | 3.58 | 805.86 | 5,552.00 | 6,018.64 | 32.58 | 4,180 | 12,409.08 |
| 4.000 | 4.23 | 1,842.62 | 9,736.10 | 12,398.77 | 138.43 | 8,103 | 24,115.92 |
| 4.500 | 2.50 | 842.49 | 8,087.69 | 5,908.00 | 640.92 | 3,985 | 15,479.10 |
| 5.000 | 2.04 | 817.27 | 5,020.03 | 4,817.70 | 172.34 | 3,032 | 10,827.34 |
| | 52.33 | $22,808.07 | $84,808.07 | $118,521.22 | $3,757.39 | 86,486 | $229,961.39 |
| Average per mile | | $435.85 | | $2,264.88 | | 1,653 | $4,394.44 |

The seven classes of roads now included in the specifications of the Michigan State Highway Department embrace a variety of types suited to the needs of all sections of the State. They have been developed largely with a view of utilizing local materials as far as possible. While the rising costs and traffic requirements are making it increasingly difficult for many counties to build roads commensurate with their needs, the wide range of types and costs make it possible to build improved roads in many sections where the higher types of surfaces would be out of the question. Thus the best interests of the whole State are being served.

* * *

## North Carolina

*Sampson County*—

The road between Roseboro and Autryville is nearing completion. A greater effort is being made on this road than has been made heretofore, and in a short while this county will have as good sand-clay roads as any county in the State. The county prisoners are at work on the road between Roseboro and Clinton. There are at least six squads of hired labor in the county. The county also has a highway inspector who gives his entire time to the work.

*Wake County*—

Most of the main roads and all of the main highways have been repaired since the heavy rains, and are in good condition. There is a repair force on the National Highway through Garner. This force was hired to the city of Garner to repair this highway through the city limits. The work will be finished in a few days and the road will then be in better condition than it has been in since it was built. The Cary and Leesville highways have been recently repaired and are in good shape. The Capital-to-Capital Highway through Wake Forest is completed with the exception of about three miles. There are two forces at work on this road; one at the Franklin County line, and the other about eight miles out on Edwards Hill. This hill is an "eye sore," and has been a menace to travel for years. The road was in a steep gorge with banks fifteen feet high. It has now been relocated and will be a beautiful piece of road, standard grade. When this stretch of road is completed, Wake will have on this highway forty-five miles of splendid road, entirely across the county, with the exception of a small stretch of very bad road in New Hill.

One of the floating camps has finished the work at Holly Springs and moved to Cary, where they will work on the roads around Cary. Camp No. 1 will finish the Fuquay Springs road this week and move to the Holly Springs road. Camp No. 3 has completed the Method and Oberlin roads and is now at work on the Hillsboro road. Camp No. 8 has finished the Milburnie road ten miles out, and is now building a mile of road at Eagle Rock, on this same road. At this place there were two bad hills and two branches that often became impassable, especially for autoists. This has now been relocated, and the road will bridge the branches.

*Chatham County*—

Cape Fear Township sold its bond issue of fifty thousand dollars to E. L. Fuller and Company, of Cleveland, Ohio. It is stated that this money is to be used in building the connecting link of the National Highway between Moncure and the Wake County line. It is also stated that the citizens of Haw River Township, in Chatham County, will vote on a ten-thousand-dollar bond issue. This is an additional bond issue to the twenty-thousand-dollar issue voted six months ago.

It is said that the Road Commissioners of Center Township have bought four mules at a cost of $1,070, and have put them to work with two road machines, leveling and scraping the road from Pittsboro to Bynum. All the roads in the township will be treated the same way.

*Davidson County*—

The Board of Road Commissioners authorized the purchase of three road signs, five feet by eight feet, to be placed at the county line where the main highways enter from Rowan, Davidson, and Forsyth. On the side of entry will be the slogan, "Welcome to Davidson County. Population, 50,000; area, 500 square miles; improved roads, 200 miles.". On the other side of the sign will be, "Davidson County invites you to come back and enjoy our 200 miles of good roads."

*Forsyth County*—

The tarvia road through Waughton has been completed. Road and Centerville Hill have been rebuilt, and the approaches to Salem Creek widened. The Tobaccoville Road from Bethania to the Stokes line, four miles, has been constructed. An important link of two miles on the High Point Road has been completed. Four miles of soil road toward Pine Hall, direct to Madison, has been constructed to the county line. The construction of the Germantown Road from Rural Hall to the Stokes line has been finished. The Red Bank Road, reaching into the Box Mountain section, a distance of two and one-half miles, as finished, opens up a new territory of good road connection. South of the city, and leading from the Salisbury road, a two-mile stretch toward Lexington, known as the Moel Road, is another important link which has been constructed. Between Dennis and Fulp, on the road betyeen Walnut and Cove, two miles of good road have been constructed. The Tricount Post Road via Clemmons, leading to the Forsyth and Davie County bridge, with co-operation of the Federal Government, has been completed. This included the rebuilding of two miles near Hanes Station and the construction of a tarvia type road from Peters Creek to the top of Hane's Hill. On the road from Brookstown to the Forsyth-Yadkin county bridge, more than four miles have been graded and partially soiled, and this will be completed at once. This road penetrates a section heretofore without any improved road. In Belew's Creek Township, an important road is being built, which leads into one of the best sections of the county, and will turn travel and trade from Guilford to Forsyth and Winston-Salem. The first concrete road of the permanent constructive type has been constructed on the Bethania road and represents some three miles. Short sections of soil road have been built on Sunnyside Avenue, from Peter's Creek to Ardmore, and leading into Old Town, in all some two miles. Also work was started on Salem Hill and the road leading from Broad Street to the Salisbury Road.

*Franklin County*—

Cedar Rock Township voted thirty thousand dollars in bonds. It is said that this will open up one of the best sections in Franklin County, giving connection with the good roads of Nash County to Nashville, Rocky Mount, and other sections of the State. The Louisburg bridge is nearing completion and promises to be a very creditable structure.

*Greene County*—

It is reported that Greene County has completed a model highway between Hookerton and Farmville. The road bed through the swamp country is being raised two feet.

*Johnston County*—

Micro Township has voted a sixteen-thousand-dollar bond issue. A four- or five-mile stretch of road, which is now in very bad condition, between Wilson and Raleigh, will be constructed from this fund.

## Highways of the State of Oregon

By John H. Lewis, State Engineer

THE State of Oregon has no well-defined program or policy for the construction of roads. Her laws are cumbersome and in many particulars conflicting and indefinite. With over one thousand State, county, and district officials acting more or less independently of each other in the matter of road expenditures, and without any very clear-cut division as to their duties and responsibilities, or convenient records as to where and how road funds are expended, conditions could not be otherwise than chaotic.

A few years ago, this fact would have been of little interest to people in adjoining States, but to-day with the development of long-distance motor vehicle traffic, and with a better understanding as to the value of good roads from a military standpoint, the condition of Oregon roads and road laws, is of vital interest to the people of Washington and to the whole United States.

Recognizing this interest, Congress has recently appropriated eighty-five millions of dollars to aid the States in the construction of roads. To receive Federal aid, co-operation from the States upon the dollar-for-dollar basis must be provided, and no project will be approved for construction unless it conforms to some comprehensive plan to be adopted at the outset. This act will insure continuity of effort and ultimately bring about the construction of inter-county and inter-state trunk roads following uniform standards as to width, grade, and alignment.

### IMPORTANT TRUNK ROADS.

One of the most important roads from the standpoint of the Federal Government, for immediate construction, is the Pacific Highway. This road extends from Canada to Mexico, through western Washington, Oregon, and California. It would be of great strategic value in case of an invasion of our coast line. It connects the principal cities of the three coast States with the most populous and productive agricultural sections. In addition, it is of great interest to the tourist as it connects many of our most interesting national parks and opens up scenic spots of unrivaled beauty.

The Pacific Highway, in both Washington and California, is about fifty per cent. complete, while in Oregon we have scarcely made a beginning. Out of three hundred and fifty miles, we have only twenty-six miles paved. There are a number of steep and dangerous hills in Josephine and Douglas counties where the present grades should be reduced. These counties cannot afford to remove these obstacles without State and Federal aid.

The Columbia River Highway, extending from the Pacific Ocean, along the south bank of the Columbia River through Portland and Pendleton to the Washington line near Walla Walla, is another road of interest to the people of the entire Northwest. This road is approximately three hundred and fifty-five miles in length. It is only partially completed. A dirt road on State standards is largely completed through Clatsop and Columbia counties. It is paved, however, through Multnomah County and for a number of miles west of Astoria. Several steep and dangerous hills in Hood River and Wasco counties must be overcome before this route will become popular for heavy, through traffic.

With the completion of the proposed cross-State route from Portland, across the Cascade Range south of Mount Hood, and up the John Day Valley to the Idaho line near Ontario, a short cut for tourists from Utah and Idaho points to the Northwest will be provided. This route is of particular interest to Oregon in that it will open a great, undeveloped section of the State to auto-truck traffic, in addition to shortening the through route about one hundred miles. This will bring new settlers and increased taxable wealth.

Both these routes, when completed, will afford communication between the great agricultural districts of eastern and western Oregon. With limited maintenance, it is believed these roads can be kept open through the mountains during ordinary winters.

Address before the Tenth Annual Meeting, Washington State Association of County Commissioners, Tacoma, Washington, September 15, 1916.

Other roads such as The Dalles-California highway will, when improved, be of great value in the development of Oregon in addition to making available to the tourist many points of interest in the great Cascade Range, which effectively divides Oregon into two parts. The Florence, Eugene, Klamath Falls Road, which crosses this mountain range will, when completed, make Klamath and Lake counties truly a part of Oregon. They are now commercially tributary to California.

SENTIMENT CHANGING.

The construction of such trunk roads has for years been opposed by many in the rural districts of Oregon. They demand first the construction of local roads which radiate from market centers.

The experience of the State in the expenditure of twenty-five thousand dollars on the Pacific Highway in the vicinity of Glendale indicates a sudden change of sentiment on the part of the rural population in this particular district. It is believed that the same reason which caused this sudden change will ultimately bring about an overwhelming sentiment for the construction and maintenance of trunk lines through State and Federal aid.

Glendale is a small town on the Southern Pacific Railway in Douglas County. In locating the Pacific Highway through this county, the State's Engineering Department recommended the adoption of a short cut which would leave Glendale on a spur road, several miles off the through route. The citizens protested to the State Highway Commission, and the longer route was adopted, notwithstanding the fact that it would add greatly to the ultimate cost of the road through having to pave four miles of unnecessary distance, in addition to compelling all through traffic to go out of its way through Glendale.

About the time it was decided to build this longer route, construction was started on a beet sugar factory at Grants Pass on the Southern Pacific Railway in the adjoining county to the south. A number of farmers on Cow Creek above the town of Glendale had contracted to grow sugar beets. They originally planned to haul by team to Glendale and ship by rail to the sugar factory. Later it developed that it would be more convenient and economical to haul by auto truck direct from the farm to the factory, and long petitions came from farmers in both counties, demanding the construction of the short-cut or trunk line, paralleling the railroad, as opposed to the roads radiating from the railroad station.

REASON FOR CHANGE OF SENTIMENT.

The economic reason for this demand is the same which causes so much confusion respecting the relative merits of rail and water transportation.

We have recently learned that the cost of handling freight in cities, including terminal charges, is so great compared with the cost of hauling for short distances up to about one hundred miles, that the transportation charge, whether by rail or water, can practically be ignored.

While sufficient data is not available to justify so definite a statement respecting auto truck and railway competition, yet judging from the radius that commercial houses in big cities of the East, where good roads are available, deliver to and receive goods from country customers, it is believed that it will be more economical and convenient to deliver by auto truck direct from the producer in the country to the consumer in the city within a radius of about fifty miles.

As there are few, if any, sections of the United States where important centers of population on railway lines are more than fifty miles apart, it is predicted that within a short time, only interurban railway corporations will be found opposing the construction of good roads paralleling railway lines. The loss in local business to transcontinental lines will be more than made up at the larger centers. The logical development is therefore trunk lines first, followed by the improvement of main county roads, or feeder lines.

Just as the railway is able to successfully compete with water transportation with certain limits, through greater convenience in receiving and delivering freight, so will the auto truck be able to successfully compete with the railway within certain limits under favorable highway conditions. Highways will, in the near future, be built with as great care and skill as railroads. Bridges and pavements will be built to withstand certain maximum loadings prescribed by law. Horizontal or vertical curves too sharp to give a safe sight distance will be prohibited. Superelevation on curves will be provided for certain safe speeds. More consideration will also be given to standardizing the width of roads and elimination of grade crossings. And those receiving special benefits will be compelled to pay license fees in proportion to the load carried.

Greater refinements in the location and construction of highways will be made as soon as the people realize the value in dollars and cents of saving in distance, rise and fall, or curvature. Many other refinements tending to promote economy and efficiency, will be introduced as definite information on road economics is accumulated. Little progress can, however, be made until such time as the people come to recognize highway construction as a serious, complicated, technical business. The work must be organized along the lines of a railway corporation. There must be some plan devised whereby continuity in service of efficient employes can be provided, so that the public may profit by the experience of these men. The longer the service, the greater the efficiency, as a rule, where so much depends upon an intimate knowledge of local materials and conditions. Laboratory tests cannot be depended upon in all cases.

CLASSIFICATION OF ROADS.

A movement is now on foot among the county judges and commissioners of Oregon for the classification of our roads and definitely fixing responsibility upon specific officers for the construction and maintenance of each of these different classes. This is the plan adopted by many of our States as well as foreign countries. It is the only plan whereby this new form of rapidly-moving traffic can be adequately cared for.

We must have a definite plan adopted by the legislature, defining the principal routes for inter-county and inter-state traffic as "State routes."

Whenever a section or portion of a "state route" has been permanently improved by the State, it should thereafter be taken over and maintained as a "State road," at the expense of the State. The county is to care for such a road prior to its becoming a "State road."

The main county roads should be built and maintained under the general direction of the county courts. These roads will serve as feeders to the main or trunk lines which will carry the concentrated traffic.

The local or district roads should be largely under district control.

Different standards should be provided for each class and sufficient overhead supervision had to insure that these standards be followed at least on inter-county and inter-state routes. In this way, such roads, when completed, will form definite links in a preconceived system or plan, adopted at the outset. A uniform system of accounting should also be provided so that the public may be conveniently informed as to how or where public funds are being expended.

ROAD POLICY.

Owing to our limited taxable wealth, and the enormous mileage of roads which must be cared for, it will be impossible to pave all the roads in Oregon at once. Nor will it be possible to pave all State roads for many years to come. It therefore becomes necessary to fix upon some program to be followed in undertaking this work, which will be equitable to all parts of the State.

At the present time we have several highly-developed sections of road with intervening stretches which are practically impassable for a small portion of the year. For instance, large sums have been expended on the Columbia River Highway in Multnomah County, and on the Pacific Highway in Jackson County, with steep and dangerous hills intervening. In places, sections of dirt roads are found between good macadam or gravel roads, thus effectively isolating the passable roads for through travel during the rainy season.

In other parts of the State, some of our shortest and best through routes have not as yet been opened up. Between some of the poorer counties, we have many steep and dangerous grades on existing roads which should be removed at the earliest possible moment.

It would thus appear to be good policy for the State to confine its energies at the outset very largely to the improvement of alignment and grade. Such work, if properly done, is quite permanent in character. If present traffic cannot be cared for on a dirt road, a gravel or macadam surface should be provided. This to serve until such time as the fills have thoroughly settled and the traffic demonstrated that a better surface is needed.

This work should be planned so that surveys could be made at least a year in advance of construction, to give ample time to secure or condemn necessary right-of-way prior to the letting of contracts.

It is believed that large sums should not be expended by the State in paving isolated portions of through routes which cannot be reached by heavy through traffic for many years to come, unless such work is undertaken in co-operation with the county and local property interests. Those immediately benefited should contribute a large share of the cost in consideration for early improvement.

With the through routes made uniformly passable at the earliest possible date, the question of paving can then be taken up and pushed as rapidly as funds are available.

A general policy as to width, grade, and alignment for roads and maximum loading for bridges should also be provided. It would lead to much waste if one county designed and built its bridges to safely carry a ten-ton road roller, while the standard in the adjoining county was a twenty-ton roller. It would also be a waste of money for one county to build a twenty-four-foot road on five-per-cent. grade to the summit of the divide, if the adjoining county was building a twelve-foot connecting road on a ten-per-cent. grade. In some sections of the State, as many as three or four abandoned grades may be noted above the present grade, and even this new grade, though recently constructed, must eventually be abandoned, where it is on a trunk line, as it is not yet down to such a grade as might be adopted for a heavily-traveled trunk road. These are some of the policies which, if enforced by some proper authority, would do much toward the early completion of a State-road system for Oregon.

PRESENT LAW.

We have upon our statute books at the present time, something over five hundred sections of law dealing with roads. This law has been gradually accumulated during the past fifty years. Many of these sections are exact duplicates. Others are duplicate as to intent. Still others are in absolute conflict. And yet one would think from a casual reading of this law, that we had all the administrative machinery necessary to insure good work.

This law provides for all the administrative officers usually found in model road codes, without eliminating those under the old system. But the administrative officers in most cases do not have the necessary power or authority to make good if entirely competent, and responsibility is so divided that it is impossible to secure credit for good work, or to fix the blame for bad work. While county courts have large powers, yet due to difference of opinion and temperament of its members, it is often difficult to pursue a definite policy or effectively plan future work.

We have a State Highway Commission, composed of the Governor, Secretary of State, and State Treasurer. These men are largely responsible for the expenditure of State road funds, amounting at the present time to only $235,000 per annum. They serve on many other similar boards or commissions. The authority of the State Engineer in road matters is somewhat indefinite. Already litigation has been found necessary to determine the intent of the legislature. Not being in control of the funds, the program of work, or the policy of the department, and occasionally being rushed into numerous small, inadequately-financed projects, it would be unfair to hold the engineer responsible for results. Nor would it be fair to hold busy members of a non-technical board responsible, even though they should innocently demoralize the technical department, through a sudden change in program or policy and make it impossible for the engineer to make good.

The county funds are supposed to be expended under the direction of the county courts. Here, again, we have more or less unfixed or indefinite responsibility.

The counties are expending annually from four to six million dollars on about thirty-seven thousand miles of roads in Oregon. The amount depending upon whether or not bonds are voted in addition to the regular road levies.

The county court, under the law, must, however, allot not less than seventy per cent. of all road levies to the road supervisors of the various districts, for expenditure. In some counties there are as many as seventy-five supervisors. In general, they are appointed upon petition from people of the district. The county courts, being elected by the people, dare not criticize the supervisors or the system. Many of these men, no doubt, do excellent work, but the difficulty from the standpoint of the public is that no convenient records are kept to show how or where this vast sum of money is being expended. This alone encourages inefficiency and waste, if nothing worse. Without a definite plan or policy, we have as many ways of doing work as there are supervisors. A new supervisor has been known to spend time and money undoing the work of the former supervisor. There is thus no chance to profit by past experience through the adoption of some definite system and the improving of this system from time to time as constructive criticism is offered.

The balance of the county funds, or thirty per cent., is expended by or under the direction of the county court on any roads in the county. Responsibility for the condition of specific roads being unfixed, the county court is often blamed where the supervisor is at fault.

The law provides for a county surveyor to be elected by the people, also for a roadmaster to be appointed by the court. But this only adds to the confusion by multiplying officers with limited powers and more or less indefinite duties. In some counties where the court confines itself to the fixing of general policies, leaving the executive work to an experienced engineer or roadmaster, some evidence of efficiency is noted. But these counties can secure little credit, as no reliable cost-keeping records exist as a basis for comparison with other counties.

We have thus one hundred and five county judges and commissioners, thirty-five county surveyors, four roadmasters, and eight hundred and sixty-two road supervisors in charge of the expenditure of from four to six million dollars per annum on county roads, and three members of the State Highway Commission, and a State Engineer in charge of the expenditure of $235,000 of State money, or over one thousand officers in all.

In general, these men are honest, and with a definite plan or policy to work to, would doubtless prove efficient. But they are disorganized. Frequent changes in office, occasional recalls, and reorganizations make it very difficult for the public to profit by past experience. Many unnecessary disputes occur between State and county officials, due to the indefiniteness of existing laws. Valuable time is thus wasted. Having only limited power and without any substantial policy to adhere to, these State and county officials are dragged around by interested property owners, enthusiastic citizens having pet projects, or by designing contractors and material men, and forced to spend public money on small, disconnected, hastily-considered, inadequately-financed, unrelated projects, without regard to the larger plans of interest to the whole people. There is thus need for a general overhauling of road laws in Oregon to the end that responsibility for road work may be definitely fixed upon responsible officers having adequate powers and some adequate provision made for continuity of effort, through a well-organized department for the completion of a general highway system for the State.

* * *

## Oklahoma

NEW CORRESPONDENCE ROAD WORK, UNIVERSITY OF OKLAHOMA.

In the winter of 1915-16, the Extension Division of the University of Oklahoma, through Professor James I. Tucker, of the School of Civil Engineering, brought out a Road Course to be given by correspondence. There were no limitations as to residence or previous education, save the ability to read English understandingly. This course was chiefly of a non-mathematical nature, inasmuch as it omitted any treatment of surveying, bridge design, or other engineering computations, save an elementary discussion of earthwork, and its costs. It was aimed to meet two needs, first, to give high-grade and correct instruction to road workers who had not received a

technical education, and second, to bring forward a large body of administrative, financial, and economic considerations for the road "booster," but which he too often neglects, or is ignorant of. The good road movement often thereby develops needless disappointments and dissatisfaction through failing to consider them.

The success of this undertaking was very gratifying, since about fifty persons are now enrolled in it, and previous to the hot season, when presumably all road workers were engaged in the field, nearly four hundred lessons had been sent in for correction. Also, it is interesting to note, about one-quarter of these students are located outside the State, scattered from California and Washington to New Jersey and Massachusetts. Numerous candidates who presented themselves for examination for the position of county engineer under the Oklahoma Road Law found the Road Course of very great assistance in making preparation for the same. The Department of Highways has throughout heartily co-operated with this undertaking.

Two new courses are contemplated for the coming season, one to follow the course just described. These will meet an existing demand from surveyors of limited training, and engineers desiring to specialize in road work.

"Surveying and Mathematics" will be given in a course of about twenty-five lessons, using McCullough's "Practical Surveying" as its basis. This text has been prepared especially for those who must be largely self-taught. In addition to giving a thorough treatment of practical surveying, it contains also the elements of Algebra and Trigonometry, subjects which many surveyors of maturity and considerable practical experience, but of limited technical education, find a decided bar to their advancement along any engineering lines. This is the very class of people, however, who must in many cases, locally assume the actual burden of carrying forward road work intelligently. To assist them to discharge their duties with satisfaction to themselves and with economy of public funds, is certainly a worthy undertaking.

The second new effort will be an "Advanced Road Course." The present, or First Road Course, uses a specially-prepared text called "The American Road." The Advanced Course will be based upon "The Construction of Roads and Pavements," a new and comprehensive text just brought out by Professor Agg, of Iowa State College. This course will begin substantially where the other leaves off. The first course treats exclusively of the earth road, including its improved forms, as sand-clay, gravel, top-soil, etc., while the advanced course will cover surveys, plans and designs for rural highway systems, the testing of road materials, and a careful consideration of various pavement types, as brick, concrete, and asphaltic construction, and their various treatments with bituminous and other products. Street design, the economics of various pavement types, the analysis of traffic needs, etc., are systematically treated, making this course nearly as much adapted to the needs of the engineer with the large-town or small-city problems to meet as to the engineer devoting himself more exclusively to county or State highway problems. The first course embraces twenty-four lessons, and the second is planned to have thirty or more. For each of these courses a nominal charge is made in accordance with a schedule fixed by the State Board of Education. Further particulars about either of the courses may be obtained by addressing Prof. James I. Tucker, of the State University, at Norman, Oklahoma.

Professor R. C. Terrell, formerly head of the Department of Rural and Highway Engineering at the University of Kentucky, and for four years previous to July first, Kentucky's first Highway Commissioner, has become associated with the School of Civil Engineering at the State University. It is believed that his extended experience along various highway lines will prove a very great asset to the whole highway movement in Oklahoma.

### STATE HIGHWAY LAW.

Since the State Highway Law went into effect in Oklahoma, some of the counties have been reluctant in conforming to the new law, but at the present time, practically all the counties in the State have complied or are attempting to comply with the provisions of the law and the instructions of the Highway Department. The county commissioners are beginning to see the benefits to be derived in having an experienced engineer in charge of the building of roads and bridges, and under the present law are getting better roads, bridges, and culverts for the amount of money expended than ever before in the history of the State. Some of the commissioners who had been against the Highway Department at the outset, are now its heartiest endorsers.

A good example of how a county engineer can save the county money recently occurred in Murray County. The Commissioner wanted to build a bridge across the Washita River west of the town of Dougherty. This county had not then complied with the State Highway Law, and had a bridge company submit plans for the bridge, which they estimated would cost ten thousand dollars. In the meantime the commissioners complied with the law and employed a county engineer. When the day came for letting the contract for this bridge, the bids were rejected, on the advice of the engineer, and the commissioners authorized the county engineer to draw plans and specifications, which was done. The result being that the county now has plans for a better bridge at an estimated cost of $7,200, which includes a reasonable profit to the contractor.

Seminole County is contemplating a bond issue of $225,000 for the building, and hard-surfacing of ninety miles of roads and $25,000 for building culverts and bridges on said roads.

This county has some of the finest road-building material in the State. Scattered all over the county are fine gravel beds with a small amount of clay mixture, so that the extreme haul for surfacing the roads is cut down to from ten to twelve miles. Tractors hauling five or six loads can handle the work very economically.

### THE OZARK TRAIL.

A sub-committee of the Ozark Trail Association met in Oklahoma City on Friday and Saturday, September 15, 16, and arranged with W. H. (Coin) Harvey, of Monte Ne, Arkansas, to take charge of the necessary publicity for promotion work leading towards the construction of the Ozark Trail through Oklahoma, and to the designation and construction from Oklahoma City west to the Texas line.

Mr. Harvey is requesting the various committees in charge of the work to finance a campaign having in view the construction of good roads for the entire route, the prime moves to be made in individual counties, and the direction of the campaign to be in the hands of Mr. Harvey and a committee selected from the organizations in each county.

The local committees from the various counties in the western district of the State have started the organization of a definite campaign leading to the building of hard-surfaced roads from Oklahoma City west, and Tulsa and Creek counties are both already working on hard-surfaced projects, with Tulsa County preparing to award contract for some seven or eight miles of soft-topped macadam pavement.

The designation of the Ozark Trail in the northeastern counties is not definitely determined, but it is hoped by means of this special Publicity Committee to definitely determine the roads and to proceed with their immediate improvement.

An effort is being made to arrange with various counties along the route to spend a portion of 1917's road funds in the building of experimental sections of roads of the local materials available in each case. Definite arrangements for doing this work have not been completed, but are well under way.

The Ozark Trail begins at St. Louis, Missouri, and terminates at Amarillo, Texas. Colonel Harvey reports that this road has been constructed and hard-surfaced from St. Louis to Joplin. When completed through Oklahoma to Amarillo, it will cut off approximately two hundred and fifty miles of the distance from St. Louis to southern California.

### DATE OF ORGANIZATION, JULY 1, 1915, TO SEPTEMBER 15, 1916.

### DATE OF ORGANIZATION, JULY 1, 1915, TO SEPTEMBER, 1916.

State roads designated and approved in entire State, 14,000 miles.

State roads constructed and in dragable condition, 5,000 miles.

Number of plans for permanent bridges and culverts approved, 1,085.

Standard forms and records prepared, 14.

Standard plans prepared for bridges and culverts, 24.

Profiles representing 4,000 miles of roads inspected and approved.

Applicants examined for position of county engineer, 129.

State road map prepared, showing entire mileage and other features.

Counties visited by engineer and rendered personal aid, 35.

Counties co-operating with the department, fully, 55.

Counties co-operating with the department, partly, 5.

Counties not co-operating, 17.

Automobile taxes for 1915, $166,000; for 1916, $475,000.

Amount returned to counties for 1915, $149,000 up to July 1; for 1916, auto tax, $340,000.

Of the one-fourth-mill State levy for road construction, $138,000 given back to various counties.

* * *

## Annual Meeting and Conference of the National Paving Brick Manufacturers' Association

The National Paving Brick Manufacturers' Association, the headquarters of which are in the Engineers' Building, Cleveland, Ohio, issues the announcement that the annual meeting will be held at Terra Haute, Indiana, on October 5, at ten o'clock a.m., at the Deming Hotel.

The construction demonstration will be held at Paris, Illinois, on the following day, and it promises to be a most interesting event.

Registration headquarters will be opened at the Deming Hotel on the evening of October 4, and both members and visitors will be required to register, at which time they will receive credentials, programs, information, etc. The registration headquarters will also be open all the following day and on the morning of October 6. There will be a Reception Committee on hand to respond to all inquiries for information, details of the meeting and demonstration, etc.

Those planning to attend the meeting and demonstration, are urged to arrive early, so adequate arrangements can be made for taking care of them on the demonstration trip. The train service entering Terra Haute from all directions is excellent. There are numerous high-speed interurban roads entering the city in addition to the steam roads.

At nine o'clock on the morning of October 6 there will be a short inspection trip over some of the old brick streets of Terra Haute, of which type there are quite a number. One of these, South Sixth Street, will be remembered by all who have used Prof. Ira O. Baker's work on "Roads and Pavements." The brick laid in this street were plain, wire-cut, and they were laid on a broken-stone foundation.

At ten o'clock on the same morning, the entire party will board interurban cars for Paris, Illinois, where some of the older streets will also be inspected. The round trip fare by interurban is sixty cents. After these streets are inspected, the entire party will be taken by automobile to the location of the construction demonstration, and this will be the special feature of the occasion.

The party will then return to Terra Haute, and shortly after arrival there a banquet will be served at the hotel. The price of this banquet will be two dollars per plate.

There are indications that there will be a large number of prominent highway officials present at the meeting and demonstration. Already, more than seventy-five have signified their intention of being present. The members of the Illinois Highway Commission will meet the party at Paris, and the highway officials of a number of other States will officially attend the conference.

Those desiring to secure accommodations at the Deming Hotel, are asked to make reservations at as early a date as possible. These reservations can either be made direct, or through Will P. Blair, Secretary of the National Paving Brick Manufacturers' Association, Engineers' Building, Cleveland, Ohio.

The conference and demonstration is considered of such importance that twelve of the leading road and engineering publications have signified their intention of having their technical representatives in attendance. No highway engineer who can possibly get to this conference and demonstration can afford to miss it.

## Eighth Annual Convention of the Southern Appalachian Good Roads Association, Lexington, Kentucky, September 5-7, 1916

By Joseph Hyde Pratt

THE Good Roads Convention recently held at Lexington, Kentucky, under the auspices of the Southern Appalachian Good Roads Association, was very successful in many ways and accomplished many of the purposes for which it was held. The following States were represented by delegates at this convention: Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama, Tennessee, Kentucky, and Mississippi. In addition to these States, there were several representatives from Ohio, New York, Michigan, and the District of Columbia. The association decided to enlarge its work by including in its membership the States of Florida, Mississippi, Louisiana, Texas, Arkansas, and Missouri. It is planned at the next meeting, which will be held in Nashville, Tennessee, to hold a Southern Road Congress under the auspices of the Southern Appalachian Good Roads Association. At this congress will be held the annual meeting of the Southern Appalachian Good Roads Association, and a meeting of the State Highway Officials of the Southern States. This will eliminate a need of a district organization of the Southern States' Highway Officials, and will increase the influence of the Southern Road Congress by having the Southern State Highway Officials hold their meeting at the same time as the association.

The meetings were well attended and a great deal of interest shown in the subjects discussed. This convention brought out a very large number of the road engineers, superintendents, supervisors, and foremen of Kentucky, and it is believed that the convention has given a great impetus to the good road work in Kentucky.

The subjects particularly discussed were:

Federal Aid to States in Road Construction.

Maintenance of Highways.

Use of Automobile Tax.

Prison Labor in Highway Construction.

Organization of Road Forces.

Main Systems of Highways (National Highways).

The first session of the convention was held Tuesday morning, September 5, in the chapel of the University of Kentucky, and was opened with prayer by Dean Robert K. Massey, of Christ Church Cathedral, followed by the address of welcome on behalf of the city of Lexington by City Attorney Harry B. Miller; on behalf of the Board of Commerce of Lexington, by President J. Clay Hunt, and on behalf of the State of Kentucky by Governor A. L. Stanley. Governor Stanley stated in his remarks that:

"Society is so organized that we must give and receive. We exchange ideas and aspirations as literally as commodities. The moral and intellectual development of the race depend upon the facility of that interchange as literally as the industrial progress of a nation upon its transportation facilities. There is no better gauge of the culture of the community, no surer index to its industrial and commercial prosperity than in the sagacity with which it determines the products which it can produce most cheaply and exchange to the greatest advantage in the markets of the world.

"The wholesome atmosphere, the seclusion, and the peace of the country home in summer did not compensate for the hardships and the complete isolation of country life in winter; where families were literally marooned by their own firesides, shut off by impassable roads from communication with their kind. The general use of the automobile and the perfection of the macadamized road has revolutionized country life and given new vigor and new prosperity to the city. For after all, the prosperity of the city springs like a plant from the soil, and in Kentucky, at least, it is impossible that the city should not instantly reflect the happiness and prosperity of the country."

In response to the addresses of welcome, Joseph Hyde Pratt, the president of the association, said, in part, as follows:

"At the time of the organization of the Southern Appalachian Good Roads Association in 1909, there were not two counties in any of the States comprising the association that

were connected with each other by good roads, thus the first work of the association was to interest the people of these States in the construction of a system of good roads in the Southern Appalachian region with connecting good roads leading down into the Piedmont and Costal Plain regions of these States. The States of Virginia, North Carolina, South Carolina, Georgia, and Tennessee, comprising the association at the beginning, entered into this work with great zeal, and results began to be obtained at once. In 1910, Maryland, West Virginia, and Kentucky entered the Association, and in 1911, Alabama. Now, 1916, the following interstate highways are completed, or well under way:

The Wilderness Road Through Kentucky.
Knoxville-Atlanta.
Asheville-Murphy-Atlanta.
Central Highway of North Carolina.
Knoxville-Cumberland Gap-Cincinnati.
Hickory Nut Gap (Charlotteville-Asheville).
Bristol-Winston-Salem (Blowing Rock Highway).
Memphis-Bristol-Washington.
Boone Way.
Bristol-Bluefield-Pittsburgh.
National Highway.
Jackson Highway.
Dixie Highway.
Southern National Highway.
Appalachian Highway.
Asheville, N. C.-Greenville, S. C.
Hendersonville, N. C.-Spartanburg, S. C.
Asheville, N. C.-Knoxville, Tenn.

"If this system and similar systems of highways, making collectively a National System of Highways, had been constructed, much of the anxiety and dread which the people of the entire United States had felt toward the recently threatened railroad strike would have been avoided. Such a system would save the business and the people of the country from serious consequences which might proceed from any possible suspension of railroad traffic.

"With the the rapid progress made in the construction of roads, the association now has another line of work to take up, and that is, to bring our States into a realization of the necessity of maintaining the good roads after they have been constructed.

"Provision must be made for a maintenance fund and this fund must not be used for any other purpose. When construction work has reached such a point in a State that the available maintenance fund will not maintain any additional mileage, then construction work should cease."

The subjects of Federal aid and national highways were discussed by E. W. James, Chief of the Division of Maintenance of the United States Office of Public Roads and Rural Engineering; Francis Kiefer, Assistant District Forester, of the United States Forest Service; Z. D. Dunlap, Assistant Director of the National Highways Association; J. J. Murray, Secretary of Tennessee Department of Highways; Cyrus Kehr, of Knoxville, Tenn.; W. S. Fallis, State Highway Engineer of North Carolina, and Rodman Wiley, Commissioner of Public Works of Kentucky. As was shown by these speakers, the passage of the Federal Aid Road Act emphasizes particularly the need of inter-county and inter-state highways (national highways), and the State Highway Departments must give more consideration to the construction of main highways throughout their States. As stated by Mr. James, the main reasons for the adoption of this Federal Aid Road Bill were:

"First. The fact that inter-state travel has increased to such an extent in recent years that an undue and improper burden has been placed on some States by reason of the traffic passing through to other States.

"Second. The necessity for constructing adequate highways for the transportation of military forces, equipment, and supplies, such highways being sometimes of small consequence to the States in which they are located, but of supreme consequence to the country as a whole.

"Third. The fact that the Federal Government has resources of revenue independent of the States, which justly may be required to contribute to the improvement of the interstate highways.

"Fourth. The advantage to the Federal Government from a political standpoint in facilitating intercourse between the people of the different States and thus preventing sectional jealousies and prejudices, which might hamper the progress and safety of the whole nation."

Mr. Kiefer referred to that portion of the bill which appropriates one million dollars per year for ten years for the construction of roads in national forest reservations, and said in part:

"In the administration of the national forests the construction of roads is constantly becoming of greater importance. Successful protection against forest fires and the full use of the various resources of the forest are dependent on roads.

"It is from the use of the resources that funds so far have been most largely responsible for the construction of roads in the national forests. So far, $4,500,000 has been paid to the School and Road Fund of States from the national forest revenues, and over one million dollars has been expended from an additional ten per cent. of the revenues, but the demands have been far in excess of the funds available, and so far, only a start has been made. There is urgent need for special legislation which would permit the advancement of funds for the construction of such roads by the forest service for the development of the present inaccessible resource. Such legislation has been enacted in the form of the Federal aid for roads, providing for the expenditure of ten million dollars a year.

"It is intended that these funds be concentrated on the most important projects to secure telling results. For the year 1917, $21,057 will be spent in the forests, which have been acquired by the Government through purchase in the Southern Appalachian States and placed on the roads to be selected, applications for which must be made by October 1, 1916. The application must describe the length, location, grade, cost and need, and set forth the co-operation to be offered by the communities, with the form of labor and the materials for the construction."

Messrs. Dunlap and Kehr spoke particularly of the need of the development of a system of national highways throughout the whole country, and showed how this bill was right in line with this.

Nearly all the speakers called attention to the section of the bill referring to the maintenance of the highways constructed by Federal aid. The States must maintain the roads built if they are to participate in future Federal appropriations. This is one of the best sections of the bill, and will, undoubtedly, lead in the end to more thorough systems of maintenance being inaugurated in the several States.

Maintenance of highways was discussed by A. G. Batchelder, chairman of the Executive Committee of the American Automobile Association, who explained plans which have been worked out in a number of States for applying the automobile tax to the maintenance of roads; by E. W. James, of the Office of Public Roads, who stated that he recognized that the cost of maintaining roads at their highest service varies with the locality and the type of road, but that their cost should be carefully figured and proper appropriation made for them; by Prof. C. M. Strahan, who discussed particularly the question of the maintenance of the dirt and sand-clay roads; and by A. D. Williams, State Highway Engineer of West Virginia, who discussed the relation between the State and county in road maintenance. Others who took part in the discussion of this subject of maintenance were, W. H. Edwards, of Woodford County, Kentucky, and Charles D. Snead, State Road Engineer of Kentucky, who spoke on the maintenance of bridges.

The resolutions passed by the convention state very clearly the purpose of the association and the work it hopes to accomplish during the coming year. These resolutions are as follows:

"Whereas, The Southern Appalachian regions covered by the territory included in the bounds of the States comprising the Southern Appalachian Good Roads Association, abounds with scenery unsurpassed and offers fields of recreation not to be found in any other section, and,

"WHEREAS, This rich scenery, healthful and attractive climate have not been enjoyed by the people of other sections of the country owing to the impassable condition of the roads and trails leading therein, and,

"WHEREAS, Thousands of people that now go abroad would sojourn in this region, therefore bringing to us the benefit of a wider acquaintanceship and association and offering to the world the advantages and pleasures of the resources within this region, and,

"WHEREAS, The purpose of this association has been and is to create enthusiasm, develop local spirit and pride, and to bring about improvement in the road so as to make possible traveling throughout all the Southern Applachian region, and to unlock unto human use and benefit the hidden treasures,

*"Therefore, be it Resolved.* First. That we renew our pledges and continued efforts to establish through education, agitation, and legislation, a complete system of roads throughout the Southern Appalachian region, and that we request all State highway officials, county officials, good roads enthusiasts, and boosters within this region and within all of the Southern States to join with us and help to bring about the desired results.

"Second. That since the last meeting of this association, Congress has passed a Federal Aid Law and established a national system of co-operation between Nation and States in the construction and maintenance of highways, therefore, we indorse the spirit manifested in the act of the Federal Government, and in the fairness of the rules and regulations promulgated by the Secretary of Agriculture and the Office of Public Roads, and we request that the States within the bounds of this association co-operate with the Government officials in the execution of a broad and comprehensive plan so as to secure the most economical application of funds to a road system that will open up and develop the territory so as to make possible interstate communication. To this end, we request that Federal and State funds be applied only on roads that will develop into interstate and intercounty highways.

"UNIFORM LEGISLATION.

"Third. That we favor the adoption of uniform legislation throughout all of the States within the Southern region providing for a State system of roads to be constructed by State, Federal, and local co-operation, and to be maintained by and under State supervision, and that a system of intercounty roads connecting the State system be established and constructed and maintained through State and county co-operation.

"Fourth. That proper maintenance of improved roads is of vast importance, therefore, we favor the establishing of the patrol system of maintenance and of the application of all automobile license tax to the maintenance of State and intercounty roads, to be applied under State supervision so as to produce continuous and uniform results.

"Fifth. That we recommend that the Executive Committee in co-operation with the American Automobile Association and the various State Highway departments, establish a uniform system of colors or emblems for the purpose of marking roads leading north and south, east and west, so as to be easily followed by persons not acquainted with the territory.

"Sixth. That we request the Executive Committee, in co-operation with the States and other organizations to have made a map of the Appalachian, as established at the Bluefield meeting in 1915.

"Seventh. That we favor uniform State laws with reference to speed of automobiles and traffic ordinance and in all other manners that uniformity will produce better results.

"Eighth. That we favor and indorse the use of Federal, State, and county prisoners and municipal prisoners in the preparation of road and street materials and in the construction and maintenance of roads and streets, believing that such employment is not only economical for the communities, but beneficial to the prisoners.

"Ninth. That during the past year destructive floods have visited sections of the Southern Appalachian region, destroying life, property, rail and public roads, and that in these sections the problem of transportation is retarding the rehabilitation of the devastated regions; therefore, we recommend that the remaining funds appropriated for these sections by the Federal Government be used under proper supervision in reconstructing the detsroyed public roads.

"Tenth. That we recommend a study of the various road building materials found within the States comprising the membership of this association, and to this end we request that the legislatures of the various States appropriate sufficient funds to enable their respective highway departments to carry out such investigations.

"Eleventh. That we recommend and request that the legislatures of the various States enact a uniform statute relating to the issuance of bonds for the purpose of road improvement; that the issuing of all such bonds be placed under the supervision of the respective highway departments and that no bonds be authorized or issued for road improvement except for grading and establishing new and important roads which will later be surfaced, and that in so far as practical, all highway bonds be made payable serially.

"Twelfth. That we favor the preparation of a field handbook and textbook covering the problems of the Southern States relating to highway construction, materials, and maintenance.

"Thirteenth. That we urge the employment of a county engineer in each county, subject to the approval of the State Highway Department.

"Fourteenth. That we thank the press of Lexington and adjoining territory for their co-operation and efforts to make the works of this meeting a success, the Phœnix Hotel for the hospitality extended, the State University, the Board of Commerce of Lexington, road officials of Fayette County, Kentucky Trotting Horse Breeders' Association, and the citizens of Lexington for their hospitality."

Nashville, Tennessee, was selected as the next meeting place of the association, and the officers elected for the following year, are:

President—Henry R. Roberts, of Bristol, Va.-Tenn.

Secretary-Treasurer—A. Gray Gilmer, of Bristol, Va.-Tenn.

State Vice Presidents—Georgia, T. C. Patterson, Athens; North Carolina, Julian S. Carr, Durham; Tennessee, Cyrus Kehr, Knoxville; Maryland, S. G. Hitchens, Baltimore; Kentucky, Peter Lee Atherton, Louisville; West Virginia, Blake Taylor, Pineville; Alabama, John Craft, Mobile; South Carolina, J. M. Jenkins, Gaffney.

Executive Committee—A. D. Williams, Morgantown, W. Va.; C. C. Crabb, Pineville, Ky.; James Maret, Mt. Vernon, Ky.; J. J. Murray, Nashville, Tenn.; W. S. Keller, Montgomery, Ala.; G. P. Coleman, Richmond, Va.; C. B. Scott, Richmond, Va.; C. S. Strahan, Athens, Ga.; H. B. Varner, Lexington, N. C.; W. S. Fallis, Raleigh, N. C.; J. H Pratt, Chapel Hill, N C.; Henry G. Shirley, Baltimore, Md.; M. V. Richards, Washington, D. C.

The recommendations of the committee were submitted to the convention to-day.

Immediately after the adjournment of the convention, the members witnessed a very interesting motion-picture demonstration of machinery showing work in the repair and reconstruction of Fayette County roads, and other Fayette County road-working scenes were also shown.

The delegates to the convention were taken to the track after luncheon and attended the races as the guests of the Kentucky Association.

In addition to the above, a resolution was passed for the Southern Appalachian Good Roads Association to affiliate with the National Highways Association.

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## The Wilmington-Goldsboro Highway

### Inaugurated at Good Roads Meeting, Warsaw, N. C., September 20, 1916

BY JOSEPH HYDE PRATT

Between six hundred and one thousand good roads enthusiasts from New Hanover, Pender, Duplin, Wayne, and Sampson counties gathered at Warsaw, Duplin County, on Wednesday, September 20, 1916, to devise ways and means for the construction of the Wilmington-Goldsboro Highway. Probably never has a more enthusiastic road meeting been held in this State, and this enthusiasm will undoubtedly be rewarded

by the construction of this highway. Nearly all of the New Hanover and Wayne County delegates came in automobiles, and in the automobile parade that preceded the meeting, there were nearly one hundred machines, each of which carried a banner calling attention to the need of the highway and the value of good roads. Ten automobiles came through from New Hanover County, and other machines brought delegates from Goldsboro, Mount Olive, Faison, Clinton, and Burgaw. The parade ended at the high-school building, and the good roads meeting was called to order in the auditorium of the school by the chairman, Mr. C. B. Middleton, of Warsaw. The invocation was made by Rev. R. H. Herring, and a very cordial welcome was extended to the members of the meeting by Rev. A. O. Moore, of Warsaw. The response to this address of welcome was made by Mr. Z. W. Whitehead, of Wilmington, who, in very appropriate words, expressed the delight of the delegates at being at Warsaw, a city that could give as warm a welcome as any in the State.

Joseph Hyde Pratt, secretary of the State Highway Commission, was then introduced by Senator R. D. Johnson, to whose efforts much of the success of the meeting was due. The subject of Mr. Pratt's address was, "Benefits of the Wilmington-Goldsboro Highway, and How to Build It." He stated that this highway would become a link in the great National Highway and would be one of the more important highways in the State. He showed the many beneficial results that the counties would derive from the construction of this highway, and suggested a plan of organization which, it is believed, will result in the construction of the highway. He also called attention to the need of maintenance of roads, and stated that unless the people would make provision for maintaining the highway, they ought not to construct it.

The next address was made by the Hon. George E. Hood, of Goldsboro, who spoke on the subject of "Federal Aid for Good Roads." He maintained that more wholesome legislation was being enacted for the benefit of the rural districts than ever before, and that this was necessary to prevent the cities from suffering on account of lack of adequate supplies being furnished by the country.

Mr. W. A. McGirt, of Wilmington, made a short talk, praising the roads around Wilmington, and saying he hoped to be a still closer neighbor to Duplin by reason of the better roads. He was followed by Mr. John Peterson, of Sampson, who spoke of the new road being built through that county, which would enable him to go to Wilmington after breakfast, spend several hours, and return in time for supper.

Mr. George Galvin, of the Wilmington Rotary Club, was the last speaker, and he said there would be no obstacle to building the highway, as far as Wilmington was concerned.

Chairman Middleton then appointed a committee to formulate plans for securing the highway, as follows: Edward Farrier, for Pender; Thomas O'Berry, for Wayne; W. A. McGirt, for New Hanover; W. L. Hill, for Dulpin.

At the close of the morning session, the delegates were all bountifully served at an old-time barbecue, which was enjoyed by all.

At the afternoon session, the committee appointed by the chairman at the morning session, made its report, suggesting that the convention organize itself into a permanent association, to be known as the Wilmington-Goldsboro Highway Association, and that an Executive Committee comprising three members from each county, a president, vice president, secretary, and treasurer, and chairman of the Executive Committee, be elected. The convention then elected the following officers and committees of the Wilmington-Goldsboro Highway Association:

President—R. D. Johnson, Warsaw.
Vice President—W. A. Brown, Rocky Mount.
Chairman—Z. W. Whitehead, Wilmington.
Secretary-Treasurer—Thomas O'Berry.

Executive Committee—Robert O'Berry, Charles Dewey, M. F. Breazeale, Wayne; J. T. Albritton, P. J. Heath, George R. Ward, Duplin; George Powers, H. P. Woodson, A. K. Parsons, Pender; W. A. McGirt, H. P. Galvin, Paul B. Bell, New Hanover.

A committee of eighteen was appointed to solicit members in the several communities along the proposed route. These are: Badger Bowden, Dudley; Fred Mitz, Mount Olive; J. R. Maxwell, Calypso; M. McD. Williams, Faison; A. R. Turnbull, Bowden; J. A. Powell, Warsaw; W. R. Newberry, Magnolia; Oscar Fussell, Rose Hill; H. D. McMillan, Teacheys; John B. Boney, Wallace; James Johnson, Willard; James Blake, Watha; W. M. Hand, Burgaw; Howard Pedin, Rocky Point; A. A. Ran, Castle Haynes; J. O. Bryan, Wilmington; Joe Parker, Goldsboro.

* * *

BOOST, Don't Knock!

The way of the Knocker may be easy and pleasing to himself for a time, but he is one of the most destructive microbes that hangs onto the road game, and wherever he goes he leaves a cloud of confusion and misunderstanding behind him.

* * *

One of the most useful men connected with the road movement is the man who is always boosting for more roads and streets, and eternally insisting upon thorough inspection and first-class construction.

* * *

The worst enemy to the cause of better roads and streets, and more better roads and streets, is the contractor who is eternally failing to live up to the specifications, and who has taken a contract at such a low price that he cannot put in the specified amounts of material without losing money on the job.

* * *

The biggest nuisance contractors and engineers have to contend with is the horde of idle men who loaf along a job, proposing what they believe to be "new ways," but really old ways which engineers have worn out and discarded twenty years ago.

* * *

The most important man on a construction job is a foreman who keeps his mind constantly on the work and is able to control his men so that their minds are constantly on the work.

* * *

During the winter months, road and street engineers and contractors have more time to read than during any other months of the year, and it is therefore necessary that they become subscribers to as many instructive publications, the subject matter of which relates to construction, repair, and maintenance of roads and streets. They can get as much real, wholesome information along this line from Better Roads and Streets as any other publication. The annual subscription price is but One Dollar, and the way to get it for one year is to send One Dollar to Better Roads and Streets, Jamestown, Ohio.

* * *

Stop a moment; think, and realize the millions and millions of dollars more expended in road and street construction in 1916 than in any other single, former year. That is certainly fine for the material and machinery manufacturers, but the people want the improvements and are perfectly willing to pay the money for them.

* * *

Edward H. Goodrich, formerly connected with the Trussed Concrete Steel Company, of Youngstown, Ohio, and Detroit, Michigan, as sales representative in Syracuse and central New York State, has severed his connection, and is now sales representative of the Northwestern Expanded Metal Company, of Chicago, with headquarters at 130 Fitch Street, Syracuse, New York. This company is a large manufacturer of road mesh, for the reinforcement of concrete roads and pavements, and expanded metal used in concrete bridges and general concrete construction.

* * *

Commissioner of Public Works A. W. Kreinheder, of Buffalo, New York, is in the market for two motor-driven street sweepers, which will be purchased this fall. It is expected that when these two machines are put to work on the streets, the cost of street cleaning will be reduced about one-half.

# Highway Construction in Legislative Halls

BY J. T. KINKAID

HIGHWAY construction in legislative halls is not as easy as it might seem to the uninitiated. When we reflect that Kansas alone, with its four hundred miles east and west and two hundred miles north and south, has a great variety of road conditions, and that the practical thing in highway construction in the eastern part of the State is not at all suited to the western part, yet in legislative halls we have a membership made up from every section of the State, we can realize that any iron-clad measures that might be drafted that would suit the eastern part of the State, would meet the opposition of those members from the western part, and vice versa. This very condition brings to my mind the one practical solution, and that is the creation of a State Highway Commission with ample power and authority to establish such standards of highway construction as are suited to the varying needs of the different counties. I want to see a highway commission created to have charge of all the road and bridge construction of the State; a highway commission that will be the administrator of all highway and bridge laws; a highway commission that will require a minimum standard of qualifications for all road officials, that maximum efficiency may be secured at minimum cost. I believe the time has come when roads must be classified according to importance, into these classes:

National highways for inter-state travel;
State highways for inter-county travel, and
Local highways for local travel.

I want to see a connected system of highways. Under the present laws the township is the unit in road construction, except such roads as are designated county roads by the County Commissioners under the road law of 1911, and under the conditions now existing we will find the roads in one township or county in splendid condition, bridges and culverts first class, while in an adjoining township or county, they will be just the opposite, the roads being undragged, rough and rutty, bridges and culverts in very bad repair, and these opposite conditions will always obtain until there is some central authority to take charge of the road building and connect up these loose ends in such a way that the highways will be continuous. It is the worst road that sets the pace and measures the load, not the good spots. I think the county is the smallest unit which should be recognized in modern road construction, and even the county systems should be so extended that they will form a chain with adjoining counties and the whole of them connected up with State and National highways, which, in the near future, I hope to see extending across the State, both north and south, and east and west. I want to see a State Highway Commission so that they may have charge entirely of our State roads, and since the Federal Congress has passed the Federal Aid Road Law, the appropriation to be distributed among the States, it is necessary to have a State Highway Commission for the proper disbursement of this fund, that it may not be all dissipated before it accomplishes the purpose for which appropriated. I want to see a State Highway Commission that will strengthen and aid and supervise local officials, for local officials must be used to meet local conditions in the various counties. It may not be known to some, but it is true that there is spent throughout the State each year for road and bridge work, a sum which exceeds the annual expenditures of every kind and nature of every department of the State government.

I want to see the administration of the automobile law taken from the Secretary of State and given to the State Highway Commission, and I think the moneys derived from this automobile tax will support the State Highway Commission for the first few years of its existence.

In keeping with the creation of the State Highway Commission, I want to see a codifying of all the road laws of the State, the ambiguous and conflicting features eliminated, and some new features incorporated. A few of the things I would like to see enacted into our road laws is a provision whereby county commissioners, by their own initiative, may alter or change the location of public highways to avoid dangerous railroad crossings, the erection of expensive bridges and culverts, and excessively heavy grades. Also a provision that highways crossing railroad tracks shall be brought to the level of the tracks for at least thirty feet on each side of the center of the track. I want to see the limit of one dollar per mile for each mile the road is dragged, and the limit of fifteen dollars a mile per year taken off entirely. I want to see the present law requiring guide posts to be erected, enforced, that travelers may know distances to the most important points throughout the State. I also want to see a complete codification of the bridge laws, and there is no legislation of more importance than this. In about sixty-five counties the State laws of 1868 are still the laws that are in force, and in practically every one of these counties, bridges that are built are built without warrant of law. These counties use the only practicable law we have, that is the law applicable to counties having a population of twenty thousand or over. I want to see a bridge code adopted by the State Highway Commission, and all plans and specifications for expensive bridges submitted to the commission for its report, which report shall be filed and be made of record by county boards before advertising for bids. I want to see a provision prohibiting the pooling of contracts by bridge companies. I want to see a provision that all plans and specifications shall be filed, adopted, and made of record by county boards before an advertisement is made of bridge lettings, and a provision that any change in the specifications after advertising, shall render a letting void. Also the estimate of costs to be filed before advertisement, and that all contracts be examined and approved by the county attorney as legal and binding on both parties, and so endorsed by him over his own signature, before the contract is in force. I want to see the present limits fixed by the statutes regarding the costs of bridges which can be built by the county commissioners without submitting to a vote of the county, very materially raised, so that better bridges may be built.

And then I want to see another thing in the way of legislation, which will require a resolution passed by two-thirds of both House and Senate, and that is a constitutional amendment to be submitted to the people for their rejection or approval at the election in 1916, which will repeal Section 8, Article II., of the State Constitution. This is the section of the Constitution which prohibits the State from engaging in internal improvements. Whenever the Federal Congress does make an appropriation, the distribution among the States will, most likely, depend upon the amount of money the State will raise for road purposes, and under a provision of that kind, the State of Kansas could not receive a single dollar. The personnel of the next Senate and House is now pretty generally known, and it is up to us who want to see the things that I have outlined, enacted into law, to get busy at once with these Senators and Representatives.

I have only outlined in a general way some of the legislation which I think most desirable in the way of laying a foundation for more effective road work, and the getting of better results from the money expended. There would be in every bill a great many details to work out, which would be too tedious to enumerate in the time we have here.

I want it distinctly understood that in my advocacy of a State Highway Commission, it is no reflection on the personnel of local officials. It only takes a moment's reflection to convince any one that all road officials are now limited by law to certain things, and that local officials are handicapped by their environments. I want to see the State Highway Commission given such elastic powers that it can handle any local situation that might develop in any county. I want this State Highway Commission to study road problems three hundred and sixty-five days in the year, a commission that can work with and not against local officials. I want a Highway Commission that will know the A, B, C—X, Y, Z of road and bridge construction, a commission with large discretionary powers, because I believe that a commission thus created will obtain better results than by any hard and fast laws that can be enacted by one hundred and twenty-five Representatives and forty Senators, a great number of whom have made no study of road and bridge construction, and know nothing of the technical work necessary to obtain the best results. We are all for good roads at the lowest possible cost, not good roads for one mile and bad roads for the next; not good roads this year and bad roads next, but good roads all the time and everywhere.

# Better Roads and Streets

Published Monthly at Dayton, Ohio
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for the
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JESSE TAYLOR, Editor-in-Chief and Business Manager, Jamestown, Ohio
GEORGE D. STEELE, Associate Editor
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Subscription Agents Wanted Everywhere Good Commissions


Two more months of road-building weather—"Make roads while the sun shines."

* * *

*Everywhere the people, and by the people we mean those who are most directly interested, the taxpayers, are demanding more thorough inspection of materials and construction.*

* * *

Robert Caldwell, who has been the city engineer of Beloit, Wisconsin, for the past fourteen years, has resigned to become city engineer of Richland Center, Wisconsin.

* * *

L. A. Granger, assistant city engineer of Fresno, California, resigned on September 1 to engage in his private engineering practice in that city. He will make a specialty of paving and other forms of municipal engineering.

* * *

The friends of Charles M. Edwards, Resident Engineer of the New York State Commission of Highways at Buffalo, New York, will be glad to learn that he has received a merited promotion, and is now division engineer.

* * *

George W. Spencer, the popular city engineer of Huntington Beach, California, has been elected city manager of that city. He will continue his activities for the improvement of every mile of street in the city.

* * *

G. N. Wood, who was formerly assistant city engineer of Douglas, Arizona, and who resigned that office to become city engineer of Chanute, Kansas, has resigned the latter position to accept the office of city engineer of Douglas, Arizona.

* * *

Ross Shreve, who recently resigned as city engineer of Tillamook, Oregon, has been succeeded by H. P. Kerr. A large paving program is being carried out by Tillamook this year.

* * *

The front cover of this issue of Better Roads and Streets was made from a photograph taken at Bexley, Columbus, Ohio, and shows a Koehring Mixer laying a hot mix on one of the principal streets.

* * *

The announcement is made that J. K. McGrath, formerly assistant engineer in charge of paving work Baltimore, Md., has resigned to accept a position in charge of the large amount of new road work in Fayette County, W. Va., made possible by the authorizing recently of a large bond issue.

C. W. Nash, formerly president of the General Motors Company, is now president of the Thomas B. Jeffrey Company, Kenosha, Wisconsin, and has announced plans for a large increase in the production of the company of which he is now the active head.

* * *

C. E. Harris, for a number of years city engineer of Norwich, New York, has resigned from that position and will devote his time to his large private engineering practice, specializing in paving, sewage, and water supply work. Mr. Harris has been succeeded by E. F. Musson, M. Am. Soc. C. E.

* * *

T. K. Legare has been appointed city engineer of Columbia, S. C. He is thoroughly familiar with the duties of the office, as he has been serving as assistant city engineer of that city for several years past, and has had charge of some important work.

* * *

The United States Motor Truck Company, Cincinnati, Ohio, has increased its capital stock from three hundred thousand to one million dollars. This step was made necessary by the great increase in the business of the concern, which was organized seven years ago, and of which R. C. Stewart is the president.

* * *

Charles D. Snead, for some time past bridge engineer of the State Highway Commission of Virginia, has resigned to become bridge engineer of the State Highway Department of Kentucky. Mr. Snead has left some fine examples of bridge design and construction behind him in his old State, and will be a valuable addition to the department forces of Kentucky.

* * *

We have just received from the National Paving Brick Manufacturers Association, Will P. Blair, Secretary, of Cleveland, Ohio, very attractive printed specifications for the construction of vitrified brick street pavements and vitrified brick country roads of the "Green Concrete Foundation Type" and the "Sand-Cement Foundation Type," which are for free distribution to all who will apply to the association for copies.

* * *

There has been a complete reorganization of the Corrugated Bar Company, which has its general offices and a large plant at Buffalo, New York. A. C. Garrison is now president of the company; A. L. Johnson is vice president and general manager; W. H. Kennedy is vice president and secretary, and A. E. Lindau is sales manager. These changes were effective on September first. The company is one of the largest manufacturers of reinforcing materials for concrete in the country.

* * *

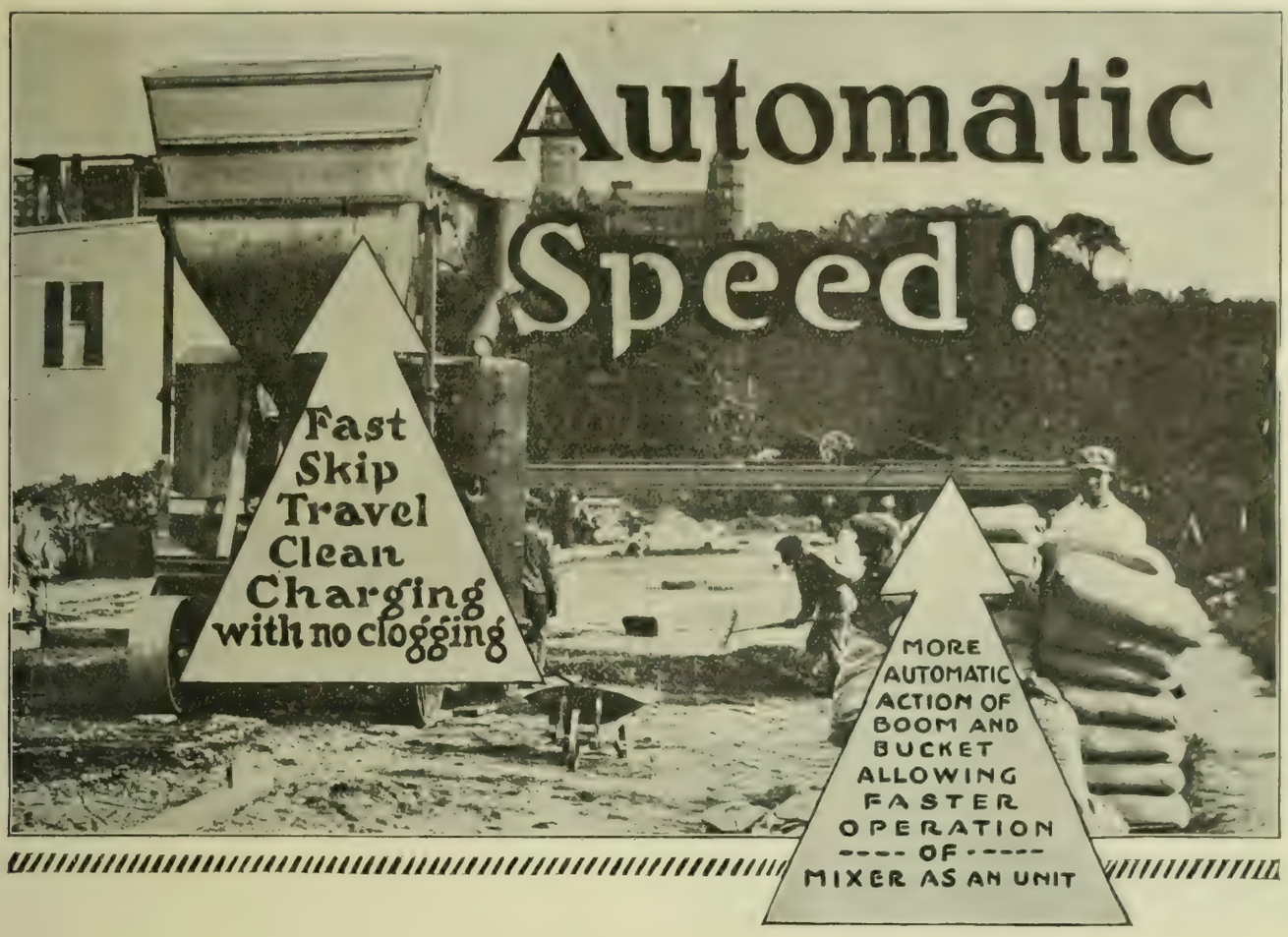
Clarence D. Pollock and George A. Taber announce that they have formed the firm of Pollock and Taber, consulting engineers on paving, street cleaning, sewage disposal, and water supply, with offices in the Park Row Building, New York City. Mr. Pollock was formerly in charge of paving in Manhattan and Brooklyn, New York City, and in San Antonio, Texas, and Havana, Cuba. Mr. Taber was formerly in charge of the work of the Department of Water Supply in the various boroughs of New York City.

* * *

All road authorities agree that drainage is the first consideration on road construction, but in traveling over the State on inspection it is found that this branch of construction is not given the attention which it deserves. There is always a tendency to lighten the drainage and foundation work in favor of the surfacing. This should be avoided and the work carried on along the best lines of engineering practice. At the time it is not always possible to satisfactorily explain the value of such work, but after a year of two, the importance of drainage and substantial grades is demonstrated.—*Minnesota State Highway Journal.*

* * *

Austin B. Fletcher, M. Am. Soc. C. E., highway engineer and executive officer of the California State Highway Commission is in the East; having been granted a temporary leave




Automatic actions—they are what save seconds and increase yardage. They never get tired! They save time on every batch, and when you are compelled to put a new operator on the job they help him to get topnotch capacity from the start.

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Gasoline power, steam power or electric power.

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For residential city streets brick is the most satisfactory for every reason upon which choice is made.

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF AUGUST 24, 1912.

of BETTER ROADS AND STREETS, published monthly at Dayton, Ohio, for October, 1916.

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Elizabeth Evans, Jamestown, Ohio.

Known bond-holders, mortgagees, and other security holders, holding one per cent. or more of the total amount of bonds, mortgages, or other securities, None.

JESSE TAYLOR, Editor.

Sworn to and subscribed before me this 23d day of September, '16.
HARRY LIEURANCE,
(SEAL) Notary Public, Greene County, Ohio.
My commission expires May 21, 1917.


of absence in order to become Chief Engineer of the United States Office of Public Roads and Rural Engineering, Washington, D. C. His experience as the secretary for many years of the Massachusetts Highway Commission, brought him into close touch with road work in the Eastern States. Later he was in charge of the road work of San Diego County, California, and then organized the State highway work of California, which he has since directed, and which comprises the magnificent system of highways throughout that State. It was believed that Mr. Fletcher's wide experience in both engineering and administration would be of much assistance at the outset of the co-operative road work of the Nation and the States, and his temporary appointment to the position of Chief Engineer is the result.

* * *

*We repeat it again—*

*"A solicitor for road machinery or road materials who goes about knocking everybody else who is engaged in the same line, is only making it harder for himself and everybody else to sell a similar machine or material, and the individual who makes a habit of reporting to his employer that some friend of the employer did not say or do the right thing at the right time is simply building a fire under himself, for in time the employer will find out from his friends who have been criticized by the employee that the employee was depending wholly upon some friend of the employer to land the job and that the employee was wholly inefficient."*

* * *

Do not lose sight of the fact that the annual meeting of the American Society of Municipal Improvements will be held this year at Newark, New Jersey, and that the dates are October 9 to 13, inclusive. The headquarters will be at the new William Treat Hotel, and reservations should be made as far in advance as possible. Those attending this meeting need have no fear of any lack of hotel accommodations, however, as was the case last year at Dayton. Newark is but fifteen minutes' ride from New York City, where excellent hotel accommodations can always be secured. It is expected, however, that the Robert Treat will be able to accommodate all who wish to make it their headquarters. The two last days of the same week, the annual meeting of the Association of Street Cleaning Officials will be held in the Municipal Building, New York City, so that those interested in this branch of city improvement will be able to attend both meetings. BETTER ROADS AND STREETS will, as in the past, publish a detailed account of both meetings.

* * *

*The most important question which should now interest engineers and road and street officials is the all-important one, "The type for the place." The editor of Better Roads and Streets does not feel wholly competent to enter into a lengthy discussion of the question, "Build the Road for the Vehicle," or "Build the Vehicle for the Road," but insists that this is one of the greatest questions which enters into the consideration of the question of how and what to build. If traffic could be made to remain stationary along one traveled route, then it would be an easier question to undertake to discuss, but routes of travel are changing almost every day, both on city streets and country roads.*

* * *

## New Roads Bureau in Salvador

The National Assembly of Salvador has created a Bureau of Public Roads, designated Direccion General de Caminos, to operate under the Ministerio de Fomento, according to a decree in a recent number of the Diario Oficial. The new bureau will be in charge of technical men who will make an exhaustive study of all plans for roads and bridges, with a view to working out a system of connecting routes which will provide means of communication for the entire country. All work relating to the construction of new roads or the repair of old ones will be administered by this roads bureau.—Commerce Reports.

* * *

## National Highway in Venezuela

Consul Homer Brett, at La Guiara, reports that the government of Venezuela has determined to undertake the con-

# THE OHIO GOOD ROADS FEDERATION

## Ohio division of the National Highways Association

## PURPOSES!

"The Ohio Good Roads Federation is an agency created for the purpose of focusing the thoughts of the people upon the best plan for improving the public roads of Ohio."

"To disseminate knowledge and increase the interest relative to the ethical and economic value of our public roads."

"To aid all efforts for their improvement."

"To advocate wise, equitable and practical road legislation."

## SERVICE!

**To the Legislator - - - To the Road Official - - - To the Citizen**

TO THE LEGISLATOR---Our Legislative Committee is familiar with the road laws of other States in the Union and with those of Ohio for the past eight years. We are collating suggestions from many sources which will be submitted to the General Assembly at its next session. Get in touch with us, so that you may be "PREPARED" to discuss all phases of this great question intelligently.

TO THE ROAD OFFICIAL---The federation thru its bulletins, booklets and general service can be of wonderful help to you in your local work. Be friendly and let us help you solve some of your perplexing problems. We've been thru the mill in taxation, legislative procedure and administrative methods. We are ready to help you—it's up to you.

TO THE CITIZEN---A community is what its people make it. The more wide-awake and enterprising citizens there are in it the greater the community life and civic pride. Interest in the improvement of roads is the duty of every citizen. A community is known by the roads it keeps, the condition of its roads is its greatest advertisement—accordingly too many communities are poorly advertised. Well-kept highways represent the thrift and industry of the people and the efficiency of the local road officials; whereas, mud, ruts, bumps, weeds and brush represent the in difference of the officials and indicates an inactive, don't-care public sentiment.

**What is your community doing? Can we help you?**

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For copies of the Road Laws of Ohio, Bulletins of the Federation and other literature, address

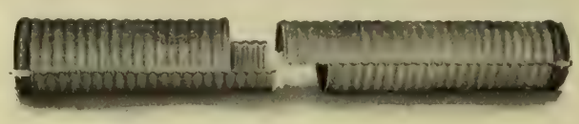
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struction of a highway from Caracas to San Cristobal in the extreme western part of the republic. This road will be the largest public work ever undertaken by the government of Venezuela; it will be six hundred and eighty-three miles in length and will run from Caracas to Valencia, San Carlos, Guanare, Barinas, and San Antonio de Caparo. The work will probably be done by the Ministerio de Obras Publicas, Caracas, without the assistance of contractors.—Daily Commerce Reports, Department of Commerce.

* * *

## Work on Highways in Colombia

The Colombian Government has decreed that work on the new northern highway from Bogota to Cucuta is to be under the direction of the Minister of Public Works, with the cooperation of the departmental governments of Cundinamarca, Boyaca, and Santander. A commission of engineers, appointed by the national government, will complete surveys for the highway, and will give instructions to the local engineers in charge of the work in each department. On completion of the principal road from Bogota to Cucuta, a branch road will be built to Bucaramanga, according to the decree in the Diario Oficial. Another decree provides that prisoners in the state penitentiaries shall work on the construction of a highway from Alban to the river Magdalena. The scarcity of railways in Colombia makes these highways of great value in transportation.—Commerce Reports.

* * *

## Extracts from Printed Rules and Regulations for Carrying Out the Federal Aid Road Act

### Issued by Direction of the United States Department of Agriculture—L. W. Page, Director of the Office of Public Roads and Rural Engineering

Items for engineering, inspection, and unforeseen contingencies not exceeding ten per cent. of the total estimated cost of the work.

Before any Federal-aid road construction will be undertaken, the Highway Department of a State must submit a project statement to the Secretary of Agriculture.

Suitable forms for project statements will be supplied by the Office of Public Roads.

Project statements for any fiscal year may be submitted at any time after the apportionment for that year shall have been made.

Projects may be deemed preferable, and recommended for approval, by the State Highway Department, in the order in which the project statements are submitted.

Each project statement shall be accompanied by a sketch map, showing the location of the proposed project and all main contiguous transportation features.

SAFETY FIRST

KYROCK

KENTUCKY NATURAL ROCK ASPHALT

THE COMING ROADWAY

The only Asphalt Surface furnishing a Safety tread for Horses and Autos. Why?

*Send for Booklet*

THE WADSWORTH STONE & PAVING CO. - - Pittsburgh, Pa.

Suitable samples of materials suggested for use in the construction of a project shall be submitted to the Office of Public Roads.

Surveys and plans shall show, in convenient form and sufficient detail, according to accepted engineering practice, necessary data, in connection with the specifications and estimates, to enable the Secretary to ascertain and pass upon locations, grades, drainage, bridges, and other structures.

Specifications shall set forth the proposed methods of construction, type of construction, materials to be used and other essentials.

The estimate for each project shall show the estimated quantity and cost of each item in detail.

Rights-of-way necessary for any project shall be provided, incidental damage to adjoining properties, and all expense thereof, shall not be included in the estimate or paid in any part, directly or indirectly, by the Federal Government.

No part of the expense of making surveys, plans, specifications or estimates, by or on behalf of the State prior to the beginning of construction work, shall be included in the estimate or paid by the Federal Government.

When plans, specifications, and estimates have been approved by the Secretary, no alternations thereof shall be made without his approval.

All projects between the State Highway Department shall be executed in duplicate.

No part of the Federal-aid money set aside on account of any project shall be paid until it has been made to the satisfaction of the Secretary.

A copy of the publication of advertisements for projects must be filed with the Office of Public Roads.

Unit bids will only be received.

A copy of the tabulated bids showing unit prices and the totals of each bid for each project must be furnished to the Office of Public Roads.

In advance of acceptance of any bids, sufficient notice of the time and place the contract is to be awarded shall be given to the Office of Public Roads.

If the contract is awarded to any other than the lowest responsible bidder, the Federal Government shall not pay more than its pro rata share of the lowest responsible bid, unless it is to be satisfactorily shown that it was advantageous to the work to accept the higher bid.

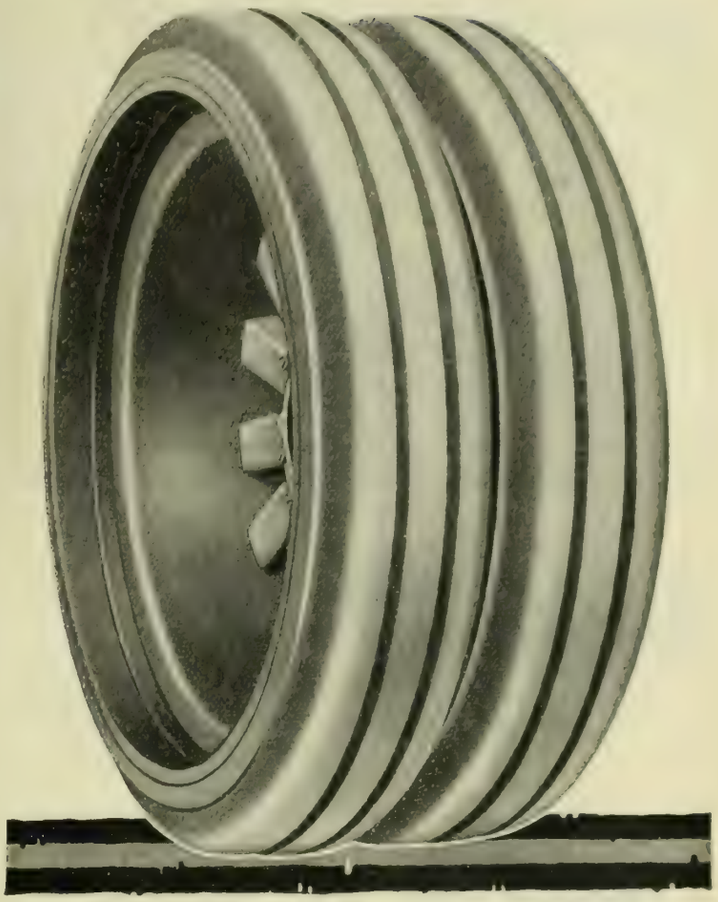
A copy of each contract, as executed, shall be immediately forwarded and furnished to the Office of Public Roads.

Specifications and plans shall be made a part of the contract.

Unless otherwise stipulated in writing by the Secretary or his authorized representative, materials to be used must be tested with specifications according to the method prescribed or approved by the Office of Public Roads.

Unless otherwise specifically stipulated in the article of agreement, bridges, viaducts, and under-head passes shall have clear right of roadway of not less than sixteen feet, and clear head-room of not less than fourteen feet for a width of eight feet in the center.

No part of the apportionment under this act shall be used, directly or indirectly, to pay or reimburse a State, county, or subdivision for the payment of any premium or royalty on any patented or proprietary material, unless purchased or obtained on open, actual, competitive bidding at the same or a less cost than unpatented articles or methods equally suitable for the same purpose.



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STERLING Trucks—from 2½ to 7 tons—are engineered on the steel railway car builders' ideas of staunchness. They're massively proportioned—giants in strength—staunch and sturdy, with stamina to stand the gaff and perform under unusual conditions.

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*Write for cost figures of motor truck operation.*

Sterling Motor Truck Company
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**RUSSELL "MOGUL"**
**Weight 7,000 lbs., 12 ft. Blade, 20 in. Wide**
The biggest and most powerful road machine made. Built for tractor power exclusively. Simple and economical in operation
**Write For Big Catalog Covering Our Full Line Of Modern Road Machinery, Bridges, Etc.**
**Free Trial Offered**




**RUSSELL GRADER MFG. CO., Minneapolis, Minn.**

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RAILS
**Road Builders' Haulage Equipment**
and advisory engineering service are saving money for road builders all over the country.
Write them about your next outfit of cars and track.
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PLANT: KOPPEL, PA.
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"For Better Roads and Streets"
PENNSYLVANIA CEMENT COMPANY
30 East 42d Street NEW YORK

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**Consulting Highway Engineer**
Broadway and 117th Street New York City

The supervision of a project by a State Highway Department shall include adequate inspection throughout the course of construction.

A written notice of commencement and completion of construction work on any project shall be given promptly by the State Highway Department to the Office of Public Roads.

Reports of the progress of construction shall be furnished from time to time whenever requested by the Secretary or his authorized agent.

A separate cost account of each project shall be sent to the Office of Public Roads.

The accounts and records, together with all supporting documents, shall be open at all times to the inspection of the Secretary or his authorized agent.

Certified copies of pay-rolls on force account shall be furnished the Secretary.

Vouchers, in the forms provided for by the Secretary, showing amounts expended on any project, shall be submitted by the State Highway Department to the Office of Public Roads.

Papers and documents required by this act or these regulations to be submitted to the Secretary, may be delivered to the Office of Public Roads.

* * *

The rapid growth in the number of commercial motor vehicles during the last five years is impressively shown in some data recently compiled by H. C. Hutchins, assistant engineer in the Manhattan Department of Public Works, with reference to traffic on Eighth Avenue, New York City. On this avenue alone, where the traffic is largely commercial, the increase in the number of motor trucks operated on that thoroughfare in less than five years amounts to five hundred and sixteen per cent.

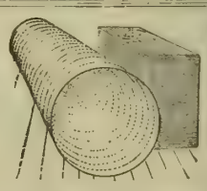
"It all goes to show, beyond any argument to the contrary, that the business man is thoroughly aware of the advantages and economy in using motor trucks, instead of horse-drawn vehicles," declared E. A. Williams, Jr., president of the Garford Motor Truck Company, of Lima, Ohio, one of the oldest and largest motor truck manufacturing concerns in the world.

"The New York figures," continued Mr. Williams, "reveal that on Eighth Avenue, which is an excellent indication of commercial traffic conditions on other streets of a like nature, traffic return in 1911 at Forty-second Street showed 4,528 horse-drawn and 1,728 motor vehicles; by the latter part of 1915, these figures had grown to 4,898 horse-drawn and 6,606 motor vehicle. These figures include all classes of motor cars. But the motor trucks showed the largest increase—from 537 in 1911 to 3,309 in 1915, or, in other words, a gain of five hundred and sixteen per cent. in less than five years. The motor traffic, as a whole, gained two hundred and eighty-three per



**JAMES H. MAC DONALD**
**Consulting Road and Pavement Expert**
Chamber of Commerce Bldg., NEW HAVEN, CONN.
State Highway Commissioner of Connecticut nearly eighteen years.
Advice given on all phases of road building and street paving.
Consultations on specifications, materials and methods. Specialty of recommending efficient and economical equipment and plant. Accurate estimates for contractors.

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**APOLLO-KEYSTONE**
**COPPER STEEL Galvanized Culvert Stock**
Demand this material in your CULVERTS—it insures the greatest possible durability and resistance to rust and corrosion. Actual time and service is the proof. Look for the Keystone added below the regular Apollo trade-mark. Send for booklet.
AMERICAN SHEET AND TIN PLATE COMPANY, General Offices: Frick Building, Pittsburgh, Pa.
*Quality—Service*



# Here You Have It Again

## Pure Iron Wire in Good Condition After 60 Years of Exposure

### This Material Contains Only the Merest Traces of Manganese, Sulpher and Copper

That iron telegraph wire may have a life of 60 years is a fact rather surprising to engineers, who have seldom estimated a life of more than 20 years. Mr. F. S. Lyman, engineer of the Interstate Commerce Commission, is authority for the statement that iron wire of the Western Union between St. Louis and Washington is still sound, although installed in 1856. It would probably be significant were a chemical analysis made of this wire.—*Editorial in Engineering and Contracting, April* 12, 1916.

Western Union Telegraph Company,
Western Division,
Chicago, June 13th, 1916.

Mr. Howard See,
Care American Rolling Mill Co.,
Middletown, Ohio.

Dear Sir:

In reply to your letter of June 10th, I have to say that I am not at this time in possession of a sample of the wire which Mr. Lyman referred to in the article which was published in the magazine "Engineering and Contracting." We, however, furnished Mr. Lyman with the data which he considered in preparing his report.

I am handing you herewith, for such use as you may decide to put it, two small samples of a wire erected on the Illinois Central Railroad in Central Illinois according to our records in the year 1855. If you decide to make a chemical analysis of these samples, I would appreciate your sending me a copy of the results which you obtain.

Yours truly,
(Signed) E. Parsons,
Division Valuation Engineer.

### *Affidavit*

State of Ohio, } SS
County of Butler. }

James A. Aupperle, being first duly sworn, deposes and [illegible] a resident of the City of Middletown, County of Butler, State of Ohio, and is employed as Chief Chemist by the American Rolling Mill Co.

Affiant deposes and says that two small samples of wire, referred to in letter of June 13th, 1916, from the Western Union Telegraph Company, were submitted to him for analysis, and that said samples were analyzed with the following results:

| | | | |
|---|---|---|---|
| Sulphur | .011 | Manganese | .005 |
| Phosphorus | .033 | Silicon | trace |
| Carbon | .031 | Copper | [illegible] |

Affidavit is made that the wires analyzed were made from iron of high purity.

Affiant further deposes and says that all of the above statements are within his personal knowledge and are true.

(Signed) James A. Aupperle.

SWORN to and subscribed before me this 13th day of July, A. D. 1916
(Signed) F. E. Vigor,
Notary Public.

Armco (American Ingot) Iron is guaranteed by its makers to be 99.84% pure iron, or, in other words, not to contain more than 16/100 of one per cent. of impurities. The average of actual analyses shows higher purity than this. In fact, a fair typical analysis of Armco Iron, as at present made, is about as follows:

| | | | |
|---|---|---|---|
| Silicon | .002% | Manganese | .020% |
| Sulphur | .020 | Oxygen | .027 |
| Phosphorus | .003 | Hydrogen | .001 |
| Carbon | .015 | Nitrogen | .002 |
| Copper | .030 | | |

Total impurities.... .121%
Iron (by difference) ....99.879%

**The Material of "Armco" Iron Corrugated Culverts Is the Purest and Most Carefully Made of Modern Irons**

**For Particulars and Prices on "Armco" Iron Culverts, Siphons, Flumes, Sheets, Plates, Roofing and Formed Products, Write to**

## Armco Iron Culvert Mfrs. Association, Cincinnati, Ohio


cent., while all classes of vehicle traffic increased sixty-eight per cent. The increase in total vehicle traffic, it is explained, was partly due to a new pavement.

"On the face of those figures, an important point is, that more and more motor trucks are being used in commercial business. There is another and more important point, however, in the interesting fact that the growth of motor truck traffic resulted in greatly increased tonnage figures. For instance, the tonnage carried October 16, 1911, by 7,022 vehicles was 13,284 tons—or an average of 1.89 tons per vehicle. On December 3, 1915, there was 31,918 tons carried in 12,102 vehicles, or 2.63 tons per vehicle.

"Those figures not only prove that the motor truck has increased the unit loading capacity of a vehicle, as Mr. Hutchins states, but that they have consequently helped to relieve the congestion, inasmuch as the total number of vehicles required to carry a given tonnage through city streets is reduced as a result of the greater loading capacity.

"As I said before, all of those figures portray most forcibly the point that the business man is rapidly becoming acquainted with the possibilities of commercial motor vehicles, and, more than that, they show what can be accomplished with reference to tonnage. The economical features of the motor truck are just as easily explained. In fact, they have been demonstrated so often that further explanation is practically unnecessary. The New York situation is simply another evidence of the passing of the horse for commercial trucking."

* * *

The United States Government, through the War Department, has purchased forty Austin sprinkling wagons from the Austin-Western Road Machinery Company for use in the Southwest. These wagons are the Austin standard six-hundred gallon, platform-spring type with steel tanks.

It is very much in favor of the construction of these machines to be able to say that the United States Army authorities have found the Austin standard construction so good that it was capable of passing their tests and standing up to the exceptionally rough work accorded these machines on the Mexican border, no alteration or reinforcement of the Austin standard construction being found necessary for this special, severe work. This ought to be a sort of assurance to the users of street sprinklers for more ordinary purposes in connection with street-cleaning departments where the service is not anything like so severe, and accounts for the long life which this Austin equipment possesses.

* * *

## Where Highway Engineering May Be Studied

### Universities and Colleges that Provide Special Instruction in this Branch of Civil Engineering—Advanced Work in Post-Graduate Courses—Winter Schools for Practicing Road Officials

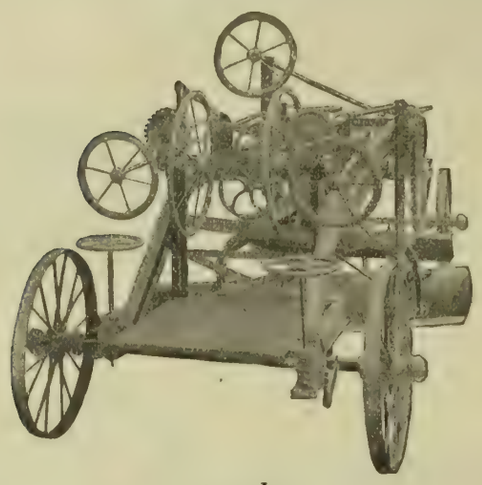
With the growing importance of highway improvement and the increasing need for trained road engineers throughout the country, there is a growing demand for educational facilities in this branch of civil engineering. First and second year engineering students can specialize in highway engineering in the junior and senior years with a feeling of certainty that the field offers ready employment and better chances for rapid progress than almost any other engineering field.

There are comparatively few engineering colleges and universities, however, that provide special instruction in highway work that will qualify students to secure immediate employment.

Of seventy-five universities and colleges having civil engineering courses, replying to inquiries by the National Automobile Chamber of Commerce, of New York, practically all include some road engineering work during the last two years, a certain amount of which is obligatory, while a more extensive study of the subject is usually elective or optional.

The "Panama Line"

*All Controls Within Convenient Reach, Covering Every Desirable Operation*



*in the*

"PANAMA GIANT"

THE Panama Giant Road Machine has every control so placed as to be conveniently reached by the operator on the rear platform and by manipulation of these controls every desirable working position of the machine, or any particular part, may be obtained.

The Platform is low, affording the operator an unobstructed view of the work and any adjustments in the machine are easily accomplished as worm gears are used throughout.

The "Panama Giant" also incorporates several exclusive desirable features, important among which is the Panama Scarifier. This wonderful and efficient device is furnished as an extra and so controlled that it does not interfere in any sense with the blade, an advantage which every contractor and road official knows to be of great value, as it really gives two machines in one.

These and many other good points, which have definitely established the high standing of the Panama Line, are explained in detail in the Panama Line Catalog. Get a copy.

MAIL OR USE FOR MEMORANDUM

The F. B. Zieg Mfg. Co. Fredericktown, Ohio

Gentlemen:- Send your catalog as offered in Better Roads and Streets.

Name.....

Address.....

THE F. B. ZIEG MFG. COMPANY
*Fredericktown, Ohio*

TELL 'EM YOU SAW IT HERE.


Thirty-one institutions give considerable attention to highway engineering, a number providing a post-graduate course in this branch and conferring degrees of Master of Science in Civil Engineering.

While State highway engineers agree that a thorough grounding in the usual civil engineering subjects is essential, they maintain that this should be supplemented by a special course in highway work, as a few hours each week in one or two semesters in the junior and senior years is insufficient technical training to qualify men for responsible positions as road engineers. They advocate a post-graduate course in the subject.

Columbia University, in New York City, claims to be the first to establish a complete, separate, graduate highway engineering curriculum and to confer degrees of highway engineer. This was founded in 1911, under Prof. Arthur H. Blanchard, and embraces sixteen courses.

The Oregon State Agricultural College, at Corvallis, offers a four-year special course leading to a degree in highway engineering. It requires sixteen to seventeen and a half hours a week in both semesters each year.

Courses of instruction in engineering in the University of Virginia, at Charlottesville, have been rearranged to bring the highway subjects together in the winter term, making a special course taken by all civil engineering students and open to others also.

A special, two-year highway course following two years of civil engineering studies is provided by the University of South Carolina, at Columbia, which confers certificates in highway construction upon graduates.

The College of Engineering, Ohio State University, at Columbus, claims one of the best highway engineering courses in the country. It provides a graduate course in the fifth year leading to the degree of Master of Engineering.

Other institutions offering similar special graduate instruction are, the University of Michigan, at Ann Arbor; Rensselaer Polytechnic Institute, at Troy, N. Y.; Massachusetts Institute of Technology, Boston; University of Wyoming, Laramie; Iowa State College, Ames, and the University of Maine, Orono.

Extension courses in highway work for graduates of the customary four-year civil engineering courses, and open also to practicing road supervisors, engineers, surveyors, etc., are offered by Purdue University, at LaFayette, Ind.; University of Illinois, Urbana; Agricultural and Mechanical College of Texas, College Station; Pennsylvania State College, College, Pa.; Kansas State Agricultural College, Manhattan, and the University of Nebraska, Lincoln.

An extension correspondence course in highway subjects was started last January by the University of Oklahoma, at Norman. This is in addition to the civil engineering course, which embraces some study in the subject, and is intended for practicing road officials. Half a dozen States are represented in the correspondence course.

Full information regarding the highway courses at any of these institutions can be obtained from the university or college bulletins, copies of which will be sent upon receipt of request addressed to the institution.—National Automobile Chamber of Commerce.

* * *

Mr. W. H. Kestin, sales manager of the Northwestern Steel and Iron Works, Eau Claire, Wisconsin, left on September 11 for an extended trip to the coast in the interests of the mixers and concrete forms made by this company. He plans to make Spokane, Seattle, and other coast cities, returning by way of Salt Lake City and Denver.

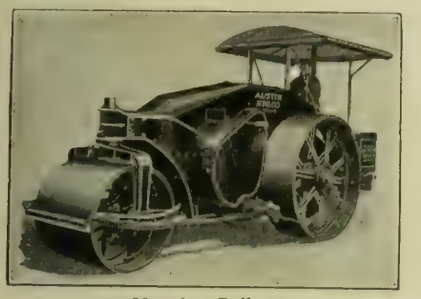
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## "Northwestern" Mixers on the Panama Canal

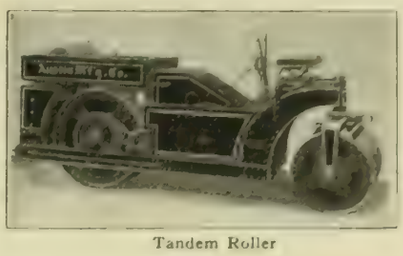
Here is an illustration of a car load of "Northwestern" Concrete Mixers recently shipped to the Panama Canal. This was an order of considerable size and is further evidence of the way in which "Northwestern" Mixers are making good in places where requirements are most exacting.

The mixers were to be used for laying foundations for lighthouses and other permanent work in the part of the canal where the banks gave way. The efforts of the Northwestern Steel and Iron Works, of Eau Claire, Wisconsin, have

# AUSTIN MOTOR (Kerosene) ROAD ROLLERS



Macadam Roller

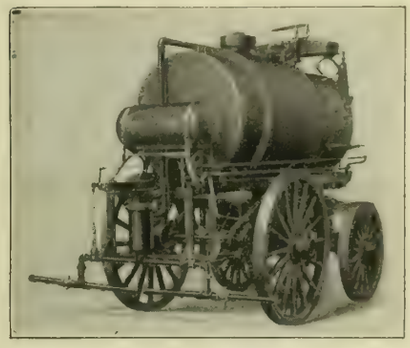


Tandem Roller

FULFILL the requirements of up-to-date road builders and contractors. A roller that saves 30 to 50 per cent. of operating costs, causes no smoke, noise and annoyance, and is always ready for work on a moment's notice is the machine that really gives the service you have a right to expect.

## *Austin Rollers Use Kerosene*

so that the temporary high price of gasoline is no argument against them. Even at present gasoline prices, our roller shows vastly greater economy than can be got from any steam roller.



Road Oiler with Heater

## The Austin Pressure Oil Distributer

Has been adapted by leading road authorities owing to its superior method of distribution and its convenience in operation. The driver controls all operations from his seat. A second man is not required.

The machine will handle any of the lighter grades of asphalt or tar without heating. When fitted with our improved heating attachment, will handle heavy grades most satisfactorily.

Full details and expert information as to the best methods of accomplishing this work will be gladly furnished by us on application.

## The Austin-Western Road Machinery Co.

Chicago, Illinois

New York City | Syracuse, N. Y. | Philadelphia | Atlanta | Dallas
San Francisco | Los Angeles | St. Paul

We manufacture a full line of road making, earth handling and rock crushing machinery. Send for our New Road Builder's Guide describing our entire line.

# Bitoslag

An Improved Asphaltic Concrete Pavement made by special process.

Especially adaptable for communities where slag abounds.

For detailed information as to License Agreements, Specifications, Etc., write

**The Bitoslag Paving Company**

**90 West Street, New York, N. Y.**



**Littleford Tar Heaters**

*The Proof of the Heater is in the Heating*



Built in sizes ranging from 50 to 900 gallons.

Especially adapted for road and street construction and maintenance work.

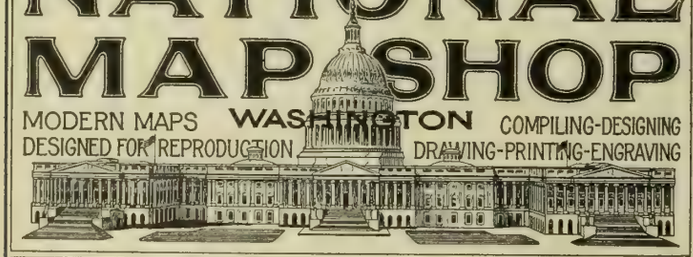
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MODERN MAPS DESIGNED FOR REPRODUCTION



COMPILING-DESIGNING DRAWING-PRINTING-ENGRAVING

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TELL 'EM YOU SAW IT HERE.

been concentrated on producing a mixer of sterling qualities at a low price. That the excellence of the "Northwestern"




Mixer is becoming more widely appreciated is well demonstrated by the orders they have received recently from various governments.

* * *

## Portable Asphalt Plants for Country Roads and City Streets

(*Continued from page 7.*)

10. It costs less to erect, dismantle, load and unload from cars than any other plant of similar capacity, and costs less for freight whenever it is shipped by rail.

11. It is built of the very best materials and in the most substantial manner, and all of the wearing parts are easily and cheaply renewed.

The value of the Warren Portable Asphalt Plant on new construction is apparent from the low operating costs in all departments of the work. These low costs are made possible wherever this plant is used. It is claimed that this advantage over all other plants is increased many times when it is used on intermittent work, such as asphalt repairs, and on any work which cannot be carried on continuously. The number of expert attendants being smaller than that required in the operation of any other portable asphalt plant, the cost of the output is said to be more nearly proportional to the amount of raw material handled.

The same advantages are claimed to hold good as regards to fuel. Little fuel oil is necessary to heat up the combustion chamber to get ready to start the plant, and the heat can be turned off at any time without any trouble, so that no fuel need be consumed when the plant is shut down waiting for calls for the paving mixture from the streets or roads where constructive work is being done, or repairs are being made. Since the drum does not revolve over a hot fire, as in the case with continuous driers, the engine need not be run when no mixture is being prepared, and there is consequently no danger of warping the drier, as is frequently the case with the former plants.

* * * * * *

In an early issue, the writer will take up another type of portable asphalt plant, describing it in detail, just as has been done in the present case with the Warren Portable Asphalt Plant.

(*To be continued.*)

* * *

## Conclusion of the Report of Committee D-4 of the American Society for Testing Materials

(*Continued from page 8.*)

or-minus millimeter); when the thermometer is at a temperature of twenty-six degrees Centigrade and plunged into a free flow of steam, the meniscus shall pass the ninety-degree mark in not less than six seconds.

The thermometer shall be set up as for the distillation test, using water, napthalene, and bensophenone as distilling liquids. The correctness of the thermometer shall be checked at 0 and 100 degrees Centigrade after each third distillation until seasoned.

(c) CONDENSER—The condenser tube shall have the following dimensions:




*Illustrating Our Sign in Use on the Cluster Light Standard in Front of City Hall, of Columbus, Ohio*

OUR GUARANTEE

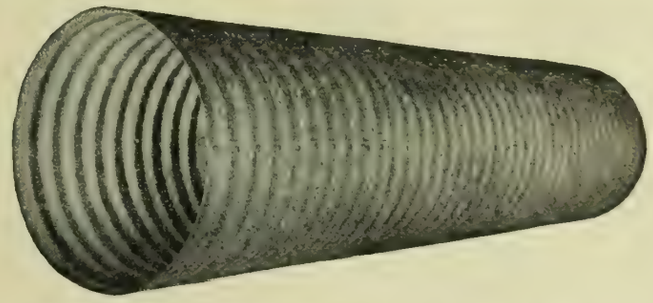
A sign, the legibility of which, cannot be destroyed by the most severe bending or striking test. A sign that is guaranteed against the cracking or breaking or deterioration from rust for a term of thirty years, on which the lettering never needs renewing. A sign on which the surface coating of the lettering and the surface finish of the plate may be renewed without removing the sign from the standard. A sign which can be refinished and made as good as new at any time at a cost not exceeding 20 per cent. of the original purchase price.

*Send for Our Booklet and Testimonials*

**The Indestructible Sign Co.**

61½ Prescott Avenue COLUMBUS, OHIO

**Buy**



# WHEELING CULVERTS

## For These Reasons:

1. They are full gauge, full size.
2. Each length of pipe is a perfect culvert.
3. The material is doubly durable—Portsmouth Iron Sheets and Portsmouth Iron Rivets—thoroughly galvanized with clean pure spelter.
4. The price of Wheeling Culverts is based on their cost of manufacture plus one small and reasonable profit only.
5. Because they have not disappointed a single purchaser and cannot otherwise than satisfy **you**.

**WHEELING CORRUGATING COMPANY, WHEELING, W. VA.**

*Branch Offices and Stores:*

NEW YORK
ST. LOUIS
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# SAVE TIME—SAVE MONEY

USE THE

## Burch Expansion Cast Iron Culvert Pipe



8 to 48 inches diameter, 3 and 4 ft. lengths.
Half sections which lock with lugs.

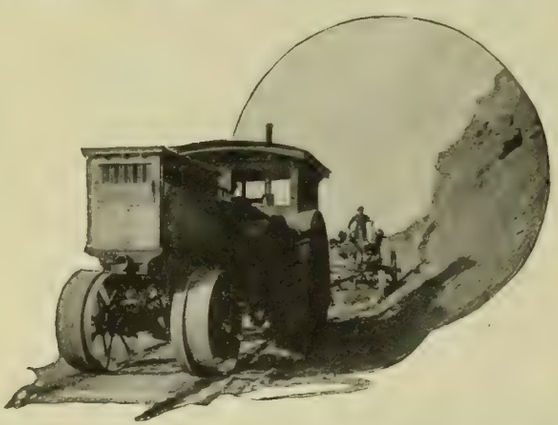
Provides for expansion and contraction. Easy to handle and lay in ditch. Requires less excavation. Strong and durable. Send for Catalog "F" giving full description of complete line.

## THE BURCH PLOW WORKS CO.

CRESTLINE, OHIO



# Mogul and Titan Tractors Operate on Kerosene and Other Low-Priced Fuels



Years ago the makers of Mogul and Titan tractors realized that if there was to be cheap power for building roads, it must come from the lower priced fuels—not from gasoline. Accordingly, the keenest inventive minds and the best skill obtainable were put to the task of designing tractors that would use kerosene as well as or better than other tractors operate on gasoline and at the same time do the most reliable work. The Mogul and Titan kerosene tractors are the successful result as experienced road commissioners and contractors know.

That is why you will find in every section of the country today, wherever highways are being bettered, International Harvester tractors in the following sizes, rendering uniform lasting good service: MOGUL 8-16 H.P., TITAN 10-20 H.P., MOGUL 12-25 H.P., TITAN 15-30 H.P., and TITAN 30-60 H.P.

Possibly your road maintenance costs are higher than they need be. Perhaps al ittle investigation would pay. Would you like to see some of the figures we have collected—some of the savings we have helped other contractors and road builders to make by changing over to Mogul or Titan kerosene tractor power? They'll cost you nothing but a two-cent stamp and a little time. Write for them.

## International Harvester Company of America

(Incorporated)

152 Harvester Building CHICAGO U S A

TELL 'EM YOU SAW IT HERE.


Adapter ..... 70 millimeters
Length of straight tube.....185 millimeters
Width of tube.....12-15 millimeters
Width of adapter end of tube.....20-25 millimeters

(d) STANDS—Two iron stands shall be provided, one with a universal clamp for holding the condenser, and one with a light grip arm with a cork-lined clamp for holding the flask.

(e) BURNER AND SHIELD—A Bunsen burner shall be provided, with a tin shield, twenty centimeters long by nine centimeters in diameter. The shield shall have a small hole for observing the flame.

(f) CYLINDERS—The cylinders used in collecting the distillate shall have a capacity of 25 cubic centimeters, and shall be graduated in 0.1 cubic centimeters.

4. The apparatus shall be set up as shown in the accompanying illustration, Figure No. 1, the thermometer being placed so that the top of the bulb is opposite the tubulature. All the connections should be tight.

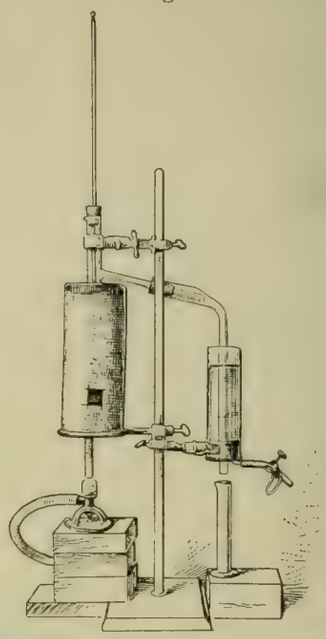


FIG. 1.—Apparatus for Determination of Distillation,

5. One hundred cubic centimeters of the dehydrated material to be tested shall be placed in a tared flask and weighed. After adjusting the thermometer, shield, condenser, etc., the distillation is commenced, the rate being so regulated that one cubic centimeter passes over every minute. The receiver is changed as the mercury column just passes the fractionating point.

The following fractions should be reported:
Start of distillation to 110 degrees Centigrade.
110 to 170 degrees Centigrade.
170 to 235 degrees Centigrade.
235 to 270 degrees Centigrade.
Residue.

To determine the amount of residue, the flask is weighed again when distillation is complete. During the distillation the condenser tube shall be warmed when necessary to prevent the deposition of any sublimate. The percentages of fractions should be reported both by weight and by volume.

### TENTATIVE METHOD FOR THE DETERMINATION OF SOFTENING POINT OF BITUMINOUS MATERIALS OTHER THAN TAR PRODUCTS.

SERIAL DESIGNATION: D——.

This method is issued under the fixed designation D——; the final number indicates the year of original issue, or in the case of revision, the year of last revision.

ADOPTED———

1. The Ring-and-Ball method shall be used.

2. The apparatus shall consist of a brass ring 15.875 millimeters (⅝-inch) in diameter, 6.35 millimeters (¼-inch deep), 2.38125 millimeters (3-32-inch) wall, suspended 25.40 millimeters (1 inch) above the bottom of the beaker; a steel ball 9.525 millimeters (⅜-inch) in diameter, weighing between 3.45 and 3.50 grammes; a standardized thermometer; a glass beaker, approximately 600 cubic centimeters capacity. (See Figure No. 2.)

3. Carefully melt the sample and fill the ring with material to be tested. Remove any excess. Place the ball in the center of the ring and suspend in the beaker containing approximately four hundred cubic centimeters of water at a temperature of five degrees Centigrade (41 degrees Fahrenheit). Arrange the thermometer bulb within one-half inch of the sample and at the same level. Apply heat *uniformly* over the bottom of the beaker in a quantity sufficient to raise the temperature five degrees Centigrade (nine degrees Fahrenheit) per minute.

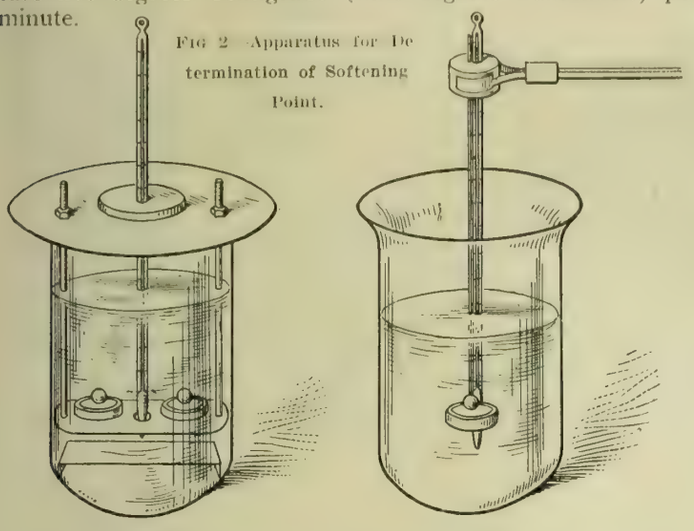


FIG 2 Apparatus for Determination of Softening Point.

Record temperature at starting the test and every minute thereafter until the test is completed. The rate of heating is very important. The softening point is the temperature at which the specimen has dropped one inch. Successive tests should average within three degrees Centigrade. For temperatures above 95 degrees Centigrade, glycerin shall be used instead of water.

* * *

## Meeting of the New York State Association of County Highway Superintendents

(*Continued from page 9.*)

in some sections of the State, which is holding up considerable of the work that has been started. Contractors this year, in every part of the State, are doing work at a loss, the burden being particularly hard on contractors who have work left over from last year, taken at last year's prices.

Commissioner Duffey stated that the State of New York has a large number of very slow road contractors, which gives the department a great deal of trouble, and said that he was very sorry to be forced to make the statement that there are also a large number of incompetent and inexperienced ones. Unfortunately, also, under the enforced method in vogue, of awarding the contract to the low bidder, many of the really good contractors get comparatively small and unimportant contracts for roads, while the smaller and inexperienced ones land large pieces of very important construction, owing to the low prices bid and their inexperience in bidding.

The suggestion was made that, in view of the extreme conditions and high prices prevailing this year, one or two lettings be made late this fall, possibly in November, so that contractors would have a chance to do whatever work possible during the winter when there would not be such a scarcity of labor. In awarding these contracts, Commissioner Duffey said, particular attention would be given to selecting roads on which there would be heavy work, so that shovels and heavy equipment could be used during the winter. This plan met with the approval of all the county superintendents present, and will, in all probability, be carried out.

The meeting was closed with an informal talk by Frank E. Bogardus, County Superintendent of Highways of Onondaga County. He stated that complete co-operation between the State Department and the counties will prove more valuable than anything else. He also brought up the point that it is exceedingly detrimental to the highway work of the State for the past custom of changing highway commissioners every two years, and that the term should be long and continuous. In the past, the department has only been organized and in good running order, when another change is made, necessitating another complete reorganization. The same thing also applies,





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We ship it in sections of any dimensions—already formed and ready for you to set in place. Lay them along the curb lines and at the ends of your unit slabs, pour your concrete and go ahead. Weather conditions can't stop your work when you use ELASTITE. No kettle to heat and no steam explosions when the hot pitch falls into the wet crack.

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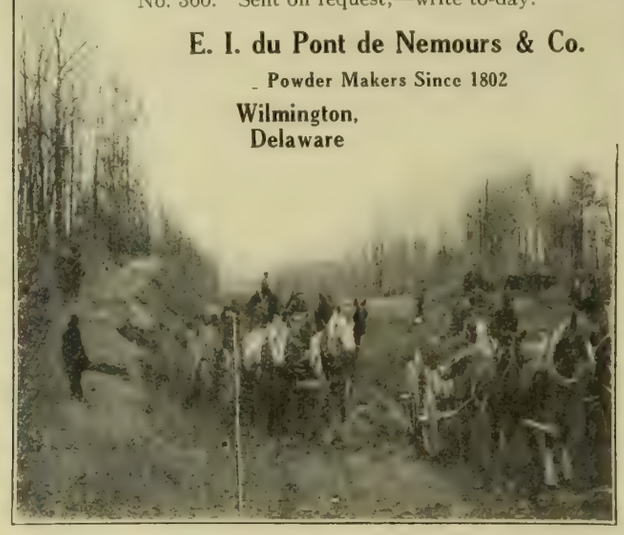
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Figure the total cost of each road covering a period of twenty years or longer and you will adopt macadam.

Get the facts before adopting your specifications.

Write us for information on stone and slag macadam, water-bound, or treated with asphalt or tar.

We can make delivery of crushed stone or slag in all parts of Northern Ohio, Eastern Ohio, Northern Indiana, and Southern Michigan.

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he said, to the terms of the County Superintendents of Highways.

Mr. Bogardus had been assigned the topic, "The Class of Road or Pavement Which Will be Most Advantageous to the Towns and Counties," but stated that he was all at sea on such a subject, as no fixed rule could be laid down which would apply, as such a subject was intended to apply. For this reason, he said, he refused to accept such a subject. Each county has its own particular highway problems to meet and work out, and a type of road that would be successful in one county could not necessarily be successful in another county. He stated that every county should remove all politics, just as he has done in Onondaga County, from the county highway department, and then good work could be done by the counties, whereas, it would be impossible to make any good showing if politics entered into the department.

In taking up the subject of equipment for the counties, Mr. Bogardus stated that in many cases that he is familiar with, towns have equipment that is used only one month in the year, and that this condition should be corrected. Onondaga County has equipment worth at least one hundred thousand dollars, and it is kept busy throughout the entire construction season. During the winter it is repaired and put in first-class condition. A force of fifty men is kept all the year round, working on road work in the summer, and during the winter making repairs, and doing other things that increase the efficiency of the county forces on construction, repair, and maintenance during the working months. Prisoners are being used on the roads of Onondaga County, and excellent results are being obtained.

* * *

## Last Year's Accomplishments of the Division Engineers of the Department of Construction of New York State Com. of Highways

(*Continued from page* 11.)

| | | |
|---|---|---|
| 3.73 | miles of bituminous macadam, penetration method, at | $10,610.00 |
| 42.68 | miles of waterbound macadam, at | 10,030.00 |
| 4.70 | miles of town macadam road adopted in the State Highway System, the surface of which was given an oil treatment, at | 840.00 |

The average cost of the completed work for last year was $10,500.00, which includes engineering and inspection.

The uncompleted roads on January first of this year include the following types, mileage, and the state of the work thereon:

| | | PER CENT. COMPLETED |
|---|---|---|
| 98.6 | miles of water-bound macadam | 39 |
| 8.9 | miles of cement concrete | 50 |
| 1.1 | miles of brick | 100 |
| 0.9 | mile of stone block | 100 |
| 1.35 | miles of Amiesite | 55 |
| 0.8 | mile of bituminous macadam, mixed type method, type 2, | 00 |
| 4.6 | miles of bituminous macadam, penetration method | 70 |

In Division No. 7 there were 61.9 miles of road completed, and there were at the beginning of the present year, 116.2 miles additional under contract, of which 42 per cent. had been completed at that time.

### Division No. 8.

The counties comprising Division No. 8 are Allegany, Chemung, Schuyler, Steuben, Tioga, Tompkins, and Yates. The division is in charge of Frederick Steele Strong, with headquarters at Hornell.

The roads completed during 1915 consist of the following types, with the mileage of each type, and the average costs per mile:

| | | PER MILE |
|---|---|---|
| 34.15 | miles of water-bound macadam, at | $10,211.00 |
| 9.49 | miles of bituminous cover on old cement concrete, at | 2,186.00 |
| 4.33 | miles of second-class cement concrete pavement with bituminous surface treatment (final not completed) | |
| 7.74 | miles of water-bound macadam (final not completed) | |

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10.46 miles of Hassam pavement, at.....$12,162.00
5.86 miles of brick pavement, at..... 40,326.00
12.99 miles of water-bound macadam with hot oil treatment, at ..... 8,718.00
22.29 miles of cancelled roads, at..... 4,201.00
0.15 mile of second-class cement concrete pavement with surface treatment, at ..... 10,233.00

At the cost per mile for brick pavement includes the amounts paid by various cities and villages for extra widths, this cost is correspondingly high. The average cost per mile for the 5.86 miles of brick pavement, based on the sixteen-foot width, which is the width on which the State shares the cost, was at the rate of $24,212.

The total cost of the above-tabulated, completed contracts was $930,407.69, or an average of $9,754 per mile of road sixteen feet in width.

The uncompleted roads at the beginning of this year in Division No. 8 embraced the following types:

| | PER CENT. COMPLETED |
|---|---|
| 4.64 miles of brick pavement..... | 92 |
| 0.37 mile of composite section brick and concrete pavement ..... | 00 |
| 0.48 mile of composite section brick pavement and water-bound macadam with cold oil treatment | 94 |
| 12.60 miles of second-class concrete pavement..... | 70.4 |
| 1.61 miles of surface treatment ..... | 00 |
| 1.52 miles of Hassam pavement ..... | 97.6 |
| 4.27 miles of cement concrete pavement, surface treatment ..... | 96.1 |
| 28.29 miles of bituminous macadam ..... | 47.4 |
| 46.15 miles of water-bound macadam..... | 51 |
| 6.87 miles of water-bound macadam with cold oil treatment ..... | 15 |
| 26.44 miles of water-bound macadam with calcium chloride treatment ..... | 16.4 |
| 5.50 miles of water-bound macadam with cold tar treatment ..... | 57.2 |
| 1.22 miles of bituminous macadam top course (only) | 94.4 |

There have been completed and accepted in Division No. 8 during the year 1915, a total of 107.46 miles of highway, and there were, at the beginning of this year, 139.96 miles under contract, of which latter amount approximately 55 per cent. have been completed.

### Division No. 9.

This division consists of the four western counties of the State, namely Cattaraugus, Chautauqua, Erie, and Niagara counties. The division is in charge of C. J. McDonough, with headquarters at Buffalo.

The roads completed during 1915 consisted of the following mileage, types of construction, and average costs per mile:

| | PER MILE |
|---|---|
| 28.6 miles of brick pavement, at ..... | $23,800.00 |
| 38.4 miles of cement concrete pavement, at..... | 14,600.00 |
| 21.6 miles of bituminous macadam, grouted at..... | 10,800.00 |
| 0.2 miles of water-bound macadam, at..... | 12,400.00 |

The average cost of completed work amounts to $16,600 per mile, including the portions paid for by the villages. This apparent high cost is due to the greater part of last year's work, consisting of brick and concrete, as well as the materially increased cost of building short stretches of road, and the extra wide improvements that were laid through the streets of cities and villages, and paid for by them.

The uncompleted roads up to the first of this year embrace the following types, with the mileage and state of the work at the commencement of the year:

| | PER CENT. COMPLETED |
|---|---|
| 21.9 miles of brick pavement..... | 49 |
| 100.7 miles of cement concrete pavement..... | 38 |
| 1.1 miles of bituminous macadam, mixed method... | 00 |
| 25.9 miles of water-bound macadam..... | 13 |
| 1.0 mile of asphalt block..... | 65 |
| 0.5 mile of stone block ..... | 00 |

The total mileage completed during 1915 amounts approximately to 89 miles, and the uncompleted work under contract amounted to 151 miles at the beginning of this year. Of the latter, about 35 per cent. had been completed and was not included in the completed mileage.



Warrenite Roadway, Columbia River Highway, Multnomah County, Ore. at Oneonta Gorge

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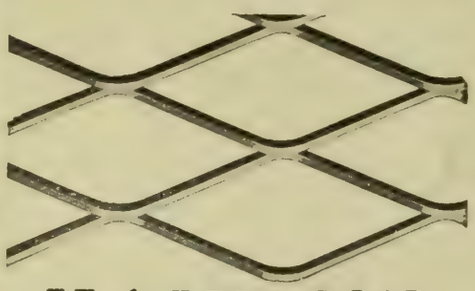
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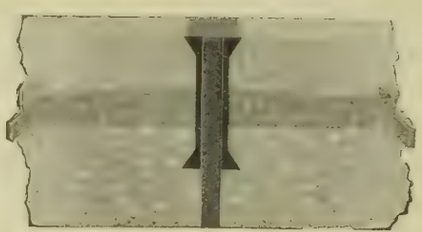
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KAHN ROAD MESH



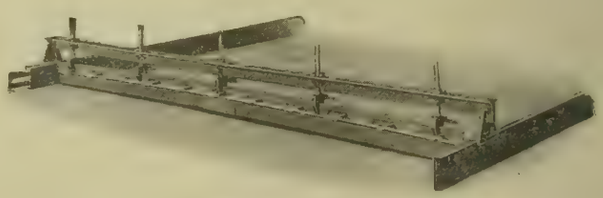
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NOVEMBER, 1916.

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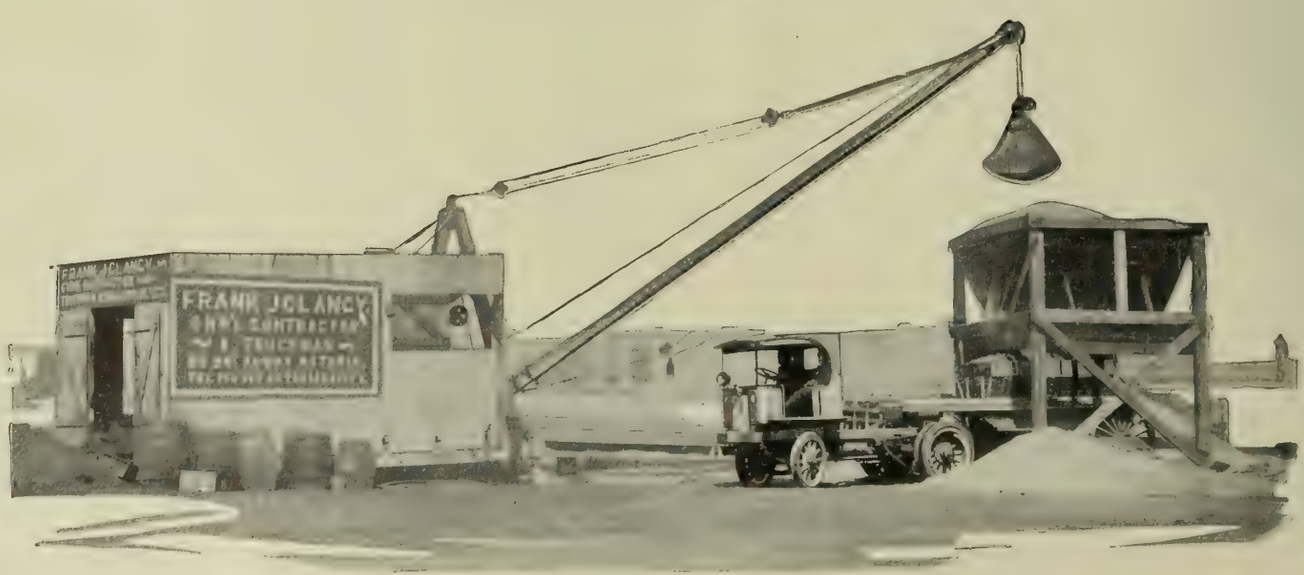
Whether your business is large or small, whether it demands short hauls or long hauls, you can profitably use a Garford Motor truck.

Garford trucks are made in all capacities from 1 to 6 tons and each is ***scientifically built*** to give the best possible service in its tonnage class.

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Better Roads and Streets

VOL. VI. NO. 11 NOVEMBER, 1916 PRICE FIFTEEN CENTS

# Portable Asphalt Plants for Country Roads and City Streets

## Descriptive Article No. 2

By George D. Steele

IROQUOIS PORTABLE ASPHALT MIXING PLANTS.

THESE plants, which are one of the best known and most used plants in this country, are manufactured by the Iroquois Works of the Barber Asphalt Paving Company, 178 Walden Avenue, Buffalo, New York. The writer recently visited their works and found them complete and modern in every detail, and admirably fitted for the manufacture of the various parts of the plants, all work incident to the construction and erection of the plants being done in the company's own works and shops.

As was done in the case of the Warren Brothers' plant, described in the October issue of BETTER ROADS AND STREETS, the description and specifications of Iroquois plants will be in detail, making it of real value and interest to all contractors and municipalities who are considering the purchase of portable asphalt mixing plants. And there will be many of these during the next few years, as contractors in all parts of the country who have been using portable plants have seen, after a few months, and in some cases, only a few weeks, use of them, that they are a most profitable investment, and that it is practically impossible to get along without such a plant if pavements are to be laid in these days of modern paving and rigid specifications so that they will give the service that is required of them under the advanced specifications that are being adopted by municipalities and township, county, and State units.

The following detailed description and specifications of Iroquois Portable Plants, equally well adapted for country roads and city streets, will, therefore, be of great interest to contractors and municipalities all over the country. Iroquois Portable Asphalt Mixing Plants represent the latest and highest development in machines of this type. They are perfectly adapted to the production of bituminous mixtures at minimum operation cost and maximum output. The several parts of the plant are the result of forty years' experience in the construction of asphalt pavements and in the design of equipment for this purpose. Their operating convenience and the excellence of the materials used throughout will also commend the plants to contractors and municipalities.

THE TWO-UNIT PLANT.

In the two-unit plant, the first unit consists of a boiler, engine, cold material elevator, heating drum, hot material elevator, screen, sand and stone storage bin, sand and stone measuring box on scales, asphalt weighing bucket, mixer, driving shaft, and all other necessary apparatus for the operation of the plant, all on four wheels. The second unit consists of one or more asphalt melting kettles.

*Capacity.*—The capacity of the two-unit plant for standard sheet asphalt, consisting of sand, filler, and the necessary amount of asphalt, is not less than eight hundred square yards of finished pavement, two inches in thickness, per working day of ten hours, providing that the material does not contain more than five per cent. of moisture with an air temperature of seventy degrees Fahrenheit, the hot sand being delivered in the weighing box at a temperature of not less than three hundred and fifty degrees, Fahrenheit.

The capacity of the same plant for producing asphalt binder, Topeka mixture, asphaltic concrete, or asphaltic macadam is very much greater than the capacity given for sheet asphalt, and is entirely dependent upon the amount of sand or other fine material contained in the mineral aggregate.

DESCRIPTION AND SPECIFICATIONS OF THE TWO-UNIT PLANT.

*Boiler.*—The boiler is of ample size and is constructed for a working pressure of one hundred and fifty pounds per square inch. It is built in accordance with the boiler inspection rules of the States of Massachusetts and Ohio, and can, therefore, be shipped into any State in the United States without further inspection being necessary on the part of the purchaser. The boiler is designed for burning coal, but oil may be used as fuel if desired. In the latter event, a small additional charge is made for installing the oil-burning apparatus.

The capacity of the boiler is so liberal that a portion of the steam may be used for operating a steam-melting kettle, and for agitation in the kettles, if desired.

*Engine.*—The engine is of the heavy duty, single-cylinder type, rated at twenty-six horse power. The size of the cylinder is nine by nine inches, and the engine is equipped with a large fly-wheel. The engine is provided with a belt-driven governor, a mechanically-driven oil feed pump for lubricating the cylinders, as well as the necessary oil and grease cups. The engine is of ample size to operate the plant under the most severe service conditions.

*Frame.*—The main frame of the plant consists of fifteen-inch, thirty-three-pound channels, properly braced, thus making the plant extremely rigid and reducing vibration to a minimum. The rear end of the plant, which carries the mixer, is raised above the ground, so that there is a clear height of six feet at this point, the center line of the mixer being three feet and in a horizontal direction from the nearest point on the main frame. This will permit a contractor's wagon to drive directly under the mixer without the necessity of raising the entire plant above the ground. No braces, jacks, or supports of any kind are required under the raised rear end or any other portion of the plant.

*Cold Material Handling Apparatus.*—The cold sand or stone is lifted into the drum by means of a chain of buckets of sufficient capacity to hoist not less than seven cubic feet of material per minute. Additional capacity may be obtained at any time by simply installing additional buckets as desired on the chain. The cold material chute for deflecting the material into the drum is a grey iron casting, the flanges of which extend inside the drum in such a manner that the material is thrown into the drum properly and at the same time no cold air can enter the drum. The chute is provided with removable steel wearing plates which can readily be replaced when worn. These plates take all the wear due to the passage of sand or stone through the chute.

The cold material elevator bucket chain is a Link Belt No. 710, or equal, with a breaking strength of twenty-two thousand pounds. A clutch is provided on the main shaft so that the cold material elevator may be thrown out of engagement without stopping the other units of the plant. The frame for holding the cold elevator boot consists of two heavy channels, securely fastened to the boot and bolted to the main frame of the plant, so that it is readily removable as a whole. The cold material elevator boot is made of heavy sheet steel, and has a device for adjusting the length of the bucket chain. The bucket line is driven by a Link Belt No. 88 chain or equal, having a breaking strength of 5,750 pounds. The material passes from the cold material elevator into the inside of the heating drum.

*Drum.*—The drum is ten feet long and four feet in diameter, of the revolving type, so designed that the maximum value is obtained from the hot gases passing through it. It is provided with eighteen staggered channel flights which distribute the material to be heated across the area of the drum in such a manner as to insure a maximum drying effect. The hot gases first pass around the drum and then through the inside of the drum, passing out through a stack provided for this purpose. Draft is obtained by means of a steam jet in the

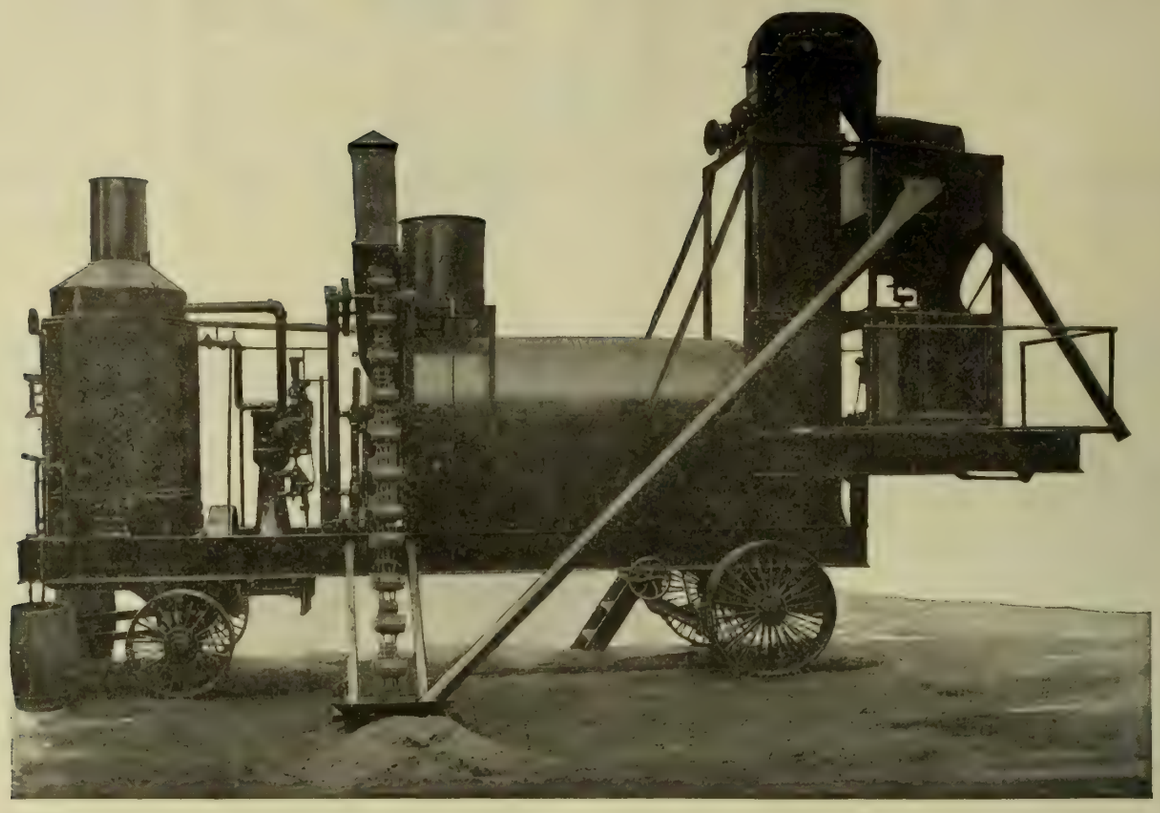


Figure No. 1

stack. The drum spiders are designed in such a manner that the material passes in and out of the drum without interference, so that there is no leakage of material at either end of the drum.

The drum is heated by means of two oil burners of the most approved type, capable of burning any grade of fuel oil. The rating of each fuel oil burner is one hundred boiler horsepower. Grates for burning coal can be furnished when desired. The drum bearings are water cooled by means of an ejector. The drum is driven by a chain, Link Belt No. 103 or equal, having a breaking strength of 9,600 pounds. A clutch is provided on the main driving shaft, so that the drum can be thrown out of engagement if desired without stopping the remaining units of the plant. The heated material passes from the drum into the hot material chute.

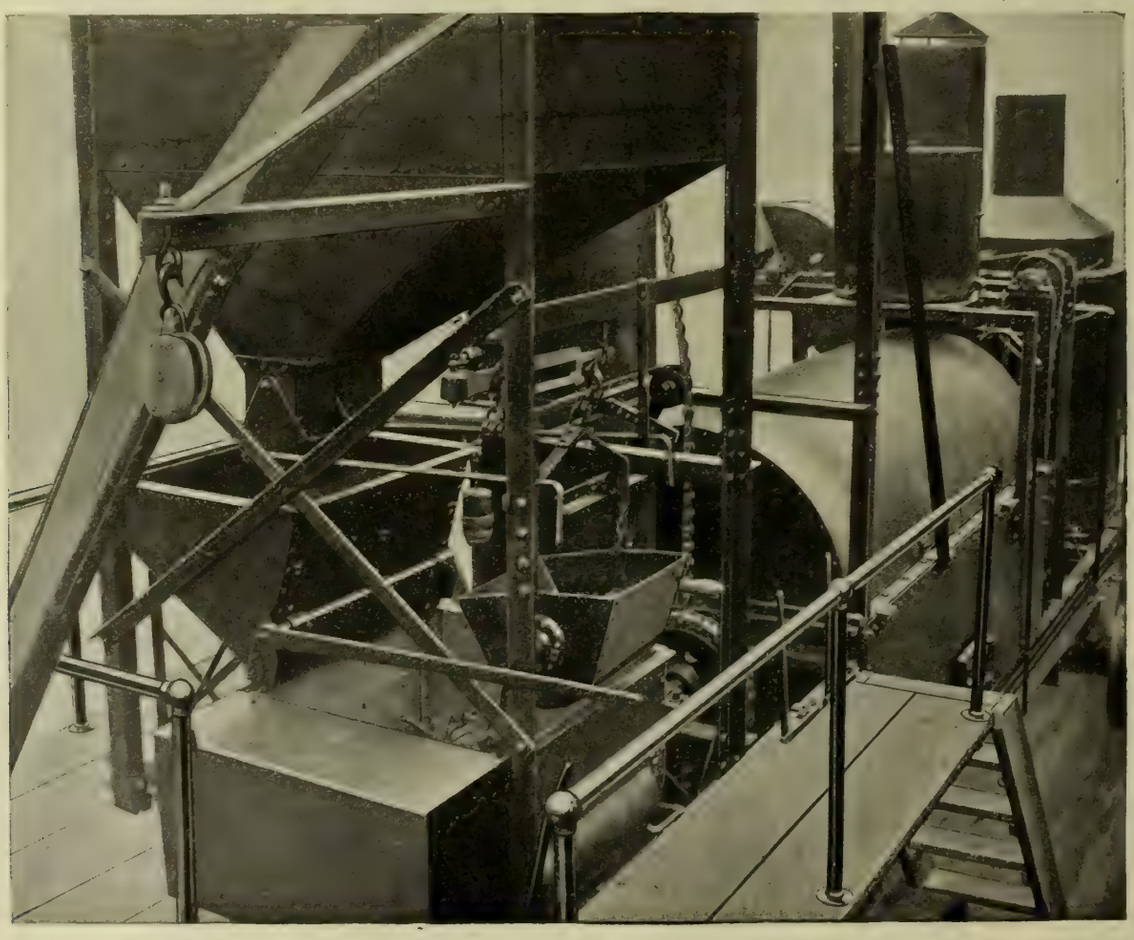


Figure No. 2—The Mixer Platform, showing convenience of all levers

Very high efficiency is claimed for a drum of this particular type, because it is entirely closed and one hundred per cent. of the heat goes through the interior of the drum, so that the heat is not short-circuited through any openings in the shell of the drum.

*Drum Setting.*—The drum setting entirely surrounds the drum, and is constructed of sheet steel of proper thickness, well reinforced with "I" beams to prevent buckling from the interior heat. The drum setting is covered with a heavy steel plate, fire roof, and a separate rain roof with an air space between them. The inside of the setting is lined with fire brick in such a manner that buckling of the outside sheets is prevented. This construction prevents radiation of heat and assures maximum fuel economy. There is a liberal air space between the brick lining and the steel setting which keeps the drum setting so cool that one can lay his hand on it at any time without danger of being burned.

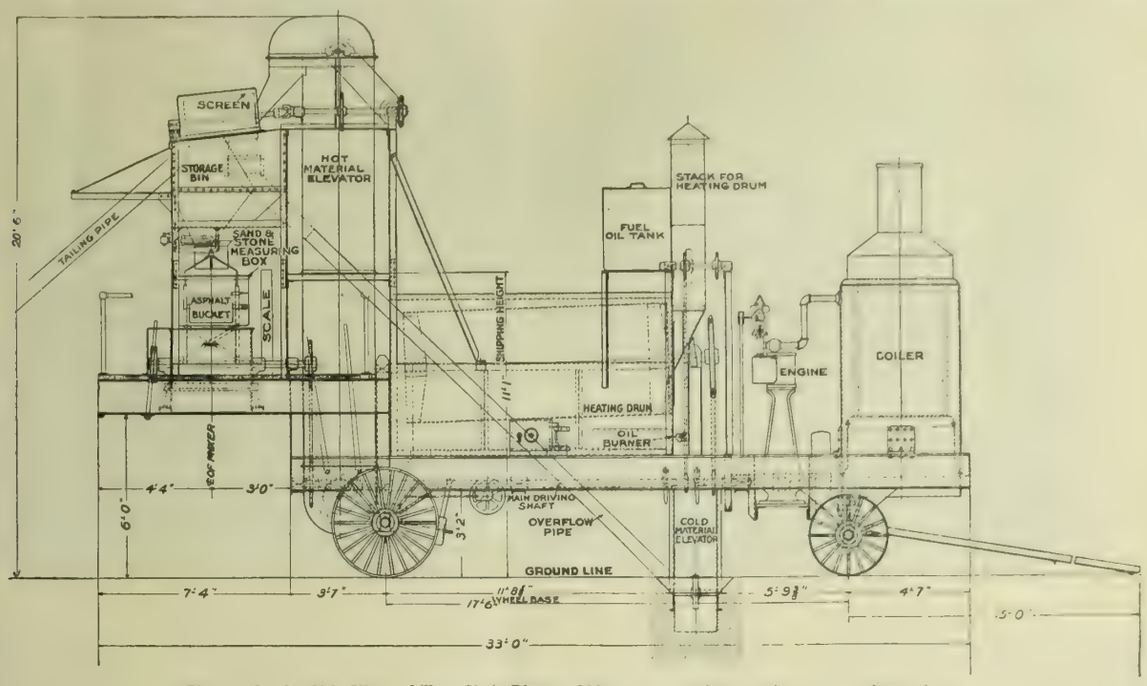



**Figure No. 3—Side View of Two-Unit Plant—800 square yards capacity per ten hour day**

*Hot Material Chute.*—This part extends inside and outside of the drum setting, receives all the heated materials and discharges them into the lower boot of the hot material elevator. This chute is provided with removable steel wearing plates. The portion of the drum extending between the drum setting and the hot material elevator is entirely covered, so that no cold air can come in contact with the hot material. A swinging gate is provided at this point which permits the material to pass out through the chute, but which also prevents cold air from being drawn into the drum housing. The heated material passes through the chute into the hot material elevator.

*Hot Material Elevator and Casing.*—The elevator consists of a chain of buckets of sufficient capacity to take care of all the material delivered by the drum. The speed of the chain is somewhat greater than the speed of the cold material elevator chain, so that material will not accumulate in the hot material elevator. The bucket chain is Link Belt No. 710, or equal, and has a breaking strength of twenty-two thousand pounds. The casing is made of sufficient thickness for the purpose and entirely surrounds the chain of buckets in such a manner that cold air cannot come in contact with the heated material. The chute for delivering the heated material into the storage bin is also entirely covered and provided with removable steel wearing plates.

The bucket line is driven by a Link Belt No. 88 chain, or equal, having a breaking strength of 5,750 pounds. A clutch is provided on the main shaft so that the hot material elevator may be thrown out of engagement without stopping the other units of the plant. An adjusting device is provided in the lower boot by means of which the length of the chain can be adjusted. The hot material passes through a chute from the hot material elevator into a screen.

*Screen and Cradle.*—This unit is mounted directly over the sand and stone storage bin, and the screen is of ample size to take care of all the material passing through it. The screen is in two sections and fine materials are screened and discharged into the smaller compartment, while the balance of the material, which is too large to pass through the screen of larger mesh, is discharged into the stone compartment or into the tailings pipe as desired by operating a gate for that purpose. The entire top surface of the bin, as well as the screen and cradle is covered with a hood so that no cold air can come in contact with the heated material. These covers eliminate, to the greatest possible extent, the escape of dust. The screen and cradle are readily removable, so that they can be eliminated if desired or screens of other mesh installed.

*Sand and Stone Bin.*—This unit is constructed of sheet steel of ample thickness and properly stiffened. The smaller compartment is for sand or dust and has a capacity of approximately twenty cubic feet. The larger compartment is for stone and has a capacity of approximately forty cubic feet. This bin is provided with a tailings pipe, through which any material, which is larger than required by the specifications under which the mixture is being made, is delivered to a convenient point on the ground, instead of being delivered into the storage bin. The tailings pipe is provided with a hinged gate, so that all material may be delivered into the storage bin, should it be desirable to do so.

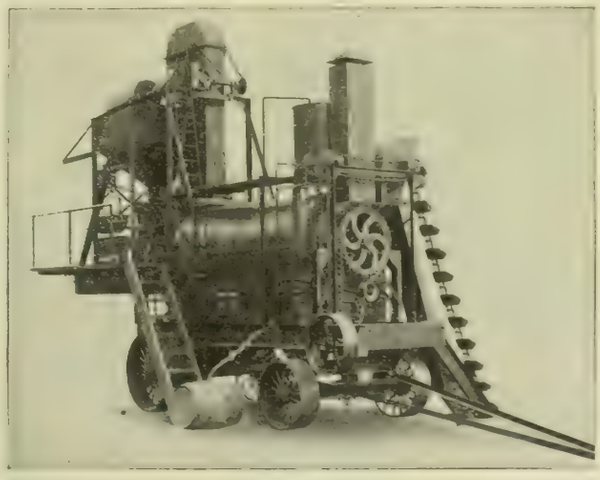


**Figure No. 4—Three-Unit Plant. Drying and Mixing Unit**

The storage bin is also provided with an overflow pipe, through which excess material is delivered back to the cold material elevator, so that the entire plant need not be shut down if the mixer is not running. The overflow pipe connects with both the sand and the stone storage compartments. It

acts as a signal for the shovelers at the cold elevator and prevents overloading the storage bin and choking up the screen.

The bin has two discharging gates, located at the bottom, from which point either sand or stone can be discharged into the measuring box, as desired by the operator.

*Sand and Stone Measuring Box.*—This unit is placed in the proper position adjacent to the mixer, and rests on three beam automatic platform scales, by means of which each grade of mineral aggregate can be weighed independently without any adjustment of weights on the scale beams. With this arrangement, the mineral aggregate may be either measured or weighed, at the option of the operator. A hinged discharge gate is located at the lowest point of the base of the box, so that the material can be discharged by gravity directly into, and the full length of, the mixer, when required.

*Asphalt Bucket.*—An asphalt bucket is supplied which will conveniently handle the proper amount of asphalt for use with the mixer supplied. It is suspended from a two-beam scale so that the asphaltic cement may be either measured or weighed at the option of the operator. The bucket can be rotated in order to discharge the asphaltic cement by gravity directly into the mixer. The bucket distributes the asphalt evenly along the entire length of the mixer, thereby assuring a homogeneous mixture.

*Asphalt Mixer.*—The asphalt mixer is the standard two-shaft Iroquois pug-mill asphalt type of seven cubic feet capacity, steam-jacketed and provided with a hand lever for dumping. A set of forty-eight cast iron topping blades and twenty-four solid manganese steel binder blades are supplied with the mixer, so that any type of asphaltic material may be produced. The mixer is provided with cast iron end liners, five-eighths of an inch thick, and sheet steel side liners, three-eighths of an inch thick. The mixer is driven from the main shaft by means of a roller chain, Link Belt SS-40, or equal, having a breaking strength of twenty-five thousand pounds. The chain has case-hardened bushings and cold rolled steel rollers, thus assuring minimum wear.

*Mixing Platform.*—A removable platform is provided consisting of two-inch planks supported on brackets fastened to the main frame of the plant. This platform has a clear width of not less than two feet on three sides of the frame, and is surrounded by a suitable pipe railing. Removable steps are provided for reaching the platform from the ground. Clutches and levers for operating the plant, with the exception of the



Figure No. 5—Two-Unit Plant in Operation. Dump Wagon being Loaded Direct from Mixer

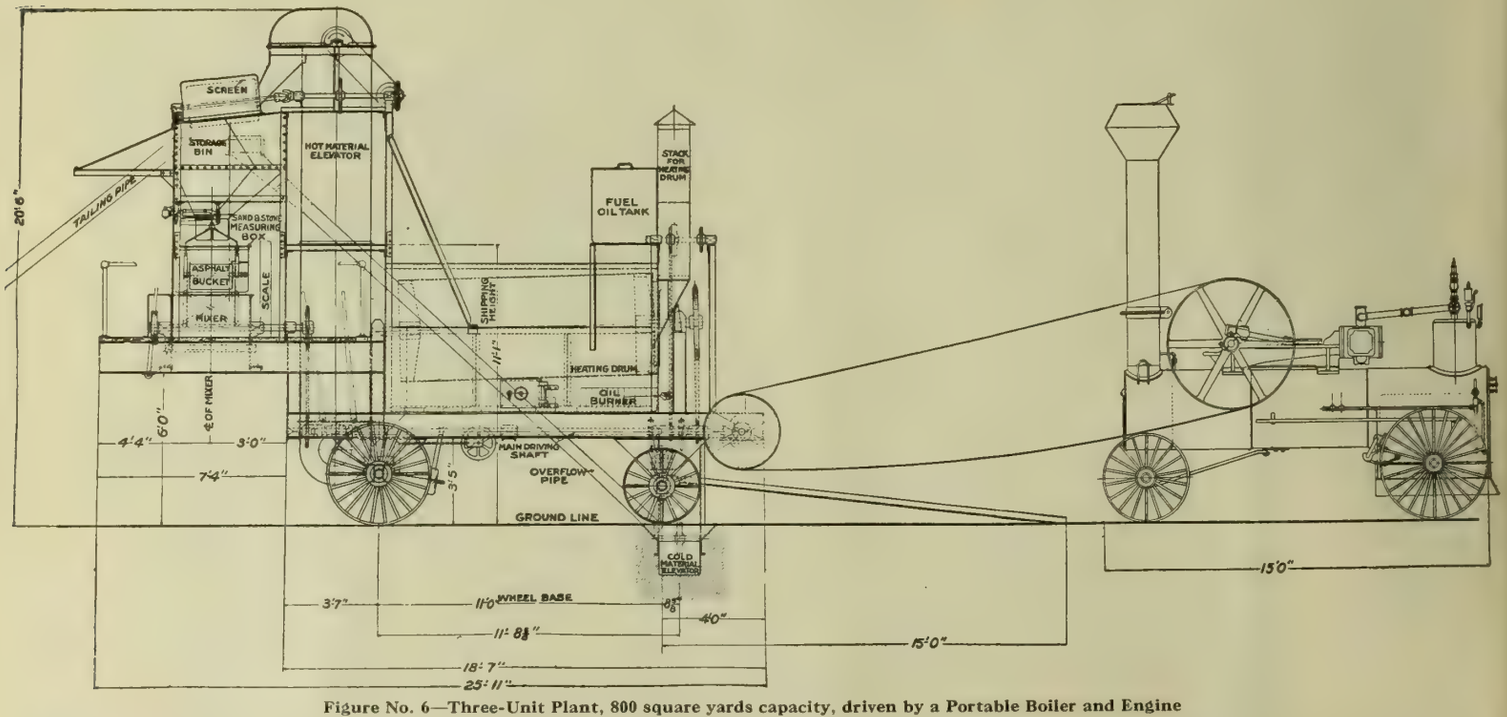



Figure No. 6—Three-Unit Plant, 800 square yards capacity, driven by a Portable Boiler and Engine

clutches for throwing out the cold material elevator and the drum, are located on one side of this platform, so that it is, in reality, a one-man platform. The levers for controlling the flow of material from the storage bin into the sand and stone measuring box, for dumping the sand and stone measuring box, for dumping the asphalt bucket, for dumping the mixer, and for throwing the mixer and hot sand elevator out of engagement, are all within convenient reach of an operator on one side of this platform. This is considered a very valuable feature, since ordinarily the arrangement is such that two men are required on the mixer platform for operating the various levers.

*Dust and Asphalt Bucket Hoist.*—A small hoist is provided projecting from the frame which supports the storage bin, by means of which an asphalt bucket or dust can be hoisted from the ground to the mixing platform. This hoist is on the same side of the mixing platform as the operating levers, so that it is conveniently arranged for the operator. If so desired, the plant is provided with a mechanically-driven, rotary asphalt pump, for which extra equipment a small additional charge is made, as this is not included in the standard equipment.

*Wheels.*—The plant is mounted on four wheels of very heavy construction, the rear wheels being forty-eight inches in diameter, with a twelve-inch face, while the front wheels are thirty-six inches in diameter, with a twelve-inch face also.

*Brake.*—The rear wheels are provided with a strong and efficient brake, with the brake wheel at the side of the plant, the holding power of the brake being sufficient to stop the plant under all ordinary conditions.

*Main Driving Shaft.*—The engine is connected, through cut gears, to the main driving shaft, which runs the full length of the plant back of the engine. This shaft is provided with clutches, by means of which the individual operating units of the plant may be thrown out of engagement without stopping any of the other units.

*Chain Tighteners.*—Chains have tighteners wherever required.

*Sprockets.*—All sprockets have chilled rims.

*Fuel Oil Tank*—An oil tank, with gauge glass, is provided above the plant for fuel oil, this tank having a capacity of approximately one hundred and ten gallons. Oil is forced into the tank by means of an ejector, so that the oil barrel need not be lifted from the ground.

*Whiffle Tree.*—The plant is provided with a whiffle tree consisting of heavy angles and channels, by means of which the plant may be hauled from one place to another. This whiffle tree is also designed to be used as a crane for assembling and dissembling certain parts of the plant which must be removed when it is shipped on a railroad car.

*General.*—The material used throughout this plant is of the best quality for the purpose intended, and the plant is designed for long continuous service with a minimum of repairs. Attention is especially directed to the removable wearing plates in all of the chutes; to the ample size of the boiler; to the economical arrangement for handling the apparatus on the mixer platform, and to the method of frame construction which permits a dump wagon to drive directly under the mixer. The latter arrangement obviates the necessity of raising the entire plant from the ground in order to deliver the mixed material into a dump wagon, thus eliminating a costly and time-consuming operation whenever the plant is moved. Excavation under the mixing platform is also eliminated, and it is not necessary to use jacks or raise the plant on blocks. There are no extra supports of any kind required, either under the mixing platform or under the frame of the plant. These features mean economical operation and long life for the plant.

*Motor-Driven, Two-Unit Plant.*—The two-unit plant can be furnished with an electric motor of sufficient capacity to drive the plant. In this type of plant, the motor is mounted on the frame, together with all necessary wiring and control apparatus, in place of the boiler and engine furnished with the standard plant. When this arrangement of plant is desired, a small steam boiler is supplied with the plant so that steam can be supplied to the mixer jackets and to the oil burner under the drum.

### SPECIAL EQUIPMENT.

A plant having a storage bin with any desired number of compartments and screens of different mesh can always be furnished. This makes it possible to weigh any graded mixture on the mixing platform.

This type of plant can also be furnished, if desired, equipped with a separate dust elevator for elevating limestone dust or cement to a compartment in the storage bin, from which it will flow by gravity to the weighing bucket.

A mechanically-driven asphalt pump and strainer of the steam-jacketed type can also, as has been stated, be furnished at small additional expense, and will be found to be a great convenience. This pump is arranged to draw the asphaltic cement from the kettle and force it through a steam-jacketed pipe to a discharge valve located directly over the asphalt bucket, where it can be easily and conveniently operated by the man on the mixing platform. This pump is provided with a by-pass and steam-jacketed return pipe leading back to the kettle. As the pump is in continuous operation, this gives a circulation of the hot asphalt when the discharge valve is closed, and provides constant agitation in the kettle. At least two men can be eliminated from the operating force when the asphalt pump is used.

### COAL-BURNING PLANTS.

In localities where it is more economical to burn coal under the drying drum, grates can be supplied for that purpose, together with the proper arrangement of the furnace and ash pit to secure the maximum amount of heat from the fuel. The standard type of portable plant provides for burning oil under the dryer, and this arrangement is recommended as preferable, wherever possible, as affording many advantages not obtained when burning coal, the principal one being the absolute control over the temperatures of the mineral aggregate.

### STATIONARY INSTALLATIONS.

For stationary use, any of the portable plants can be furnished without the wheels and axles, so that they can be located permanently on concrete piers or foundations at any desired height. This arrangement makes an ideal installation for municipalities which contemplate laying their own bituminous pavements and for repairing those which are out of guarantee.

In the eight-hundred-yard, two-unit plant which has been described in this chapter, the plant itself is one complete unit. The other unit consists of the asphalt kettles, of which two are usually furnished, each having a capacity of one thousand gallons, where an oil asphalt or a Bermudez fluxed asphalt is being used. Special kettles are provided where refined Trinidad asphalt is to be used and fluxed at the plant. In the latter case, one three-thousand-gallon kettle or three one-thousand-gallon kettles are furnished. The former kettle is steam heated, while the three smaller kettles are fire heated, all being supplied with steam agitation.

The Iroquois Works of the Barber Asphalt Paving Company, also manufacture what is known as a "Continuous Kettle," considered the "last word" in asphalt kettle construction, a brief description of which will be of interest.

This kettle is called "Continuous" because there is no waiting for material after the kettle has once been started. The charging with cold material and the drawing off of hot material is a continuous operation. A substantial rack, holding six barrels of asphalt, is installed over the top of the tank. A double door hood is provided over the tank for retaining the heat around the barrels, from which the material flows in a preheated condition. Thus there is no chilling of the hot asphalt that is already in the tank, and a clean tank is always assured.

This "Continuous Kettle" is especially designed for the road contractor who considers quality before first cost and who wants a kettle that will last a lifetime instead of the light and flimsy contrivance that is usually sold for his class of work. The kettle is wide, low, and easily get-at-able, and has double walls with a one-inch air space between on each side. This prevents the buckling of the walls of the kettle and also prevents any great amount of heat radiation. The tank is removable to facilitate cleaning, and for the making of any repairs that may become necessary. The fire box is designed for burning wood only, and extends the full length and width of the kettle, thus insuring uniform heat throughout. The Iroquois Patented Submerged Type Valve is installed inside the tank. This valve eliminates all annoyance and delay gen-

erally caused by the clogging of the ordinary draw-off pipe and outside plug cock exposed to the weather.

A substantial metal skid equipped with a windlass is furnished with each kettle, providing convenient means for elevating the barrels of asphalt from the ground to the rack. The construction of the tank, hood, and rack is of heavy steel plate on a heavy frame, while the wheels are of a substantial, all-metal type, with wide rims.

If desired by the purchaser, the kettle can be furnished with flat hinged lids instead of the hood where it is not desired to use the latter, and upon specification, grates can also be furnished.

The general dimensions of the furnace are 8 feet long, 4 feet 2½ inches wide, and the top of the tank 4 feet above the ground level. The hood extends 40 inches above the rack. The minimum output of the kettle is 1,500 gallons per day, and the shipping weight is 4,375 pounds.

The mixer used in the Iroquois portable asphalt plant is of the well-known, pug-mill type, as the manufacturers are of the firm opinion and claim that this type of mixer is unquestionably best for this particular work. In this contention, the Barber Asphalt Paving Company has collected data showing that about ninety-five per cent. of the asphalt streets that have been laid in this country have been constructed with material mixed in the two-shaft, pug-mill type mixer, so that it has undoubtedly stood the test of time. Some of the leading municipalities of this country have even gone so far as to prohibit the use of the drum, or rotating type, of mixer in connection with the laying of bituminous pavements within their corporate limits, and demand that the materials be mixed in the pug-mill type mixer.

The manufacturers of this plant strongly recommend the use of the oil-burning apparatus in connection with the dryer, as those operating it have an absolute check both on the temperature of the mineral aggregate and on the asphalt. In the case of both materials, they are placed in separate open receptacles where the temperature can be absolutely determined before they are mixed.

It is also claimed as a fact that long experience has shown that the oil flame, in spite of its intense heat, does not tend to either blister or bulge the drums. Other advantages claimed are as follows, where oil is used as heat for the drums:

1. The use of oil as fuel for heating gives a range of capacity impossible when coal is burned, since the oil burners can be forced to a very high capacity. They can also be reduced or cut down to suit any particular condition of temperature desired, or to suit any moisture content which may be encountered in the mineral aggregate. In the Iroquois plant either one or both burners can be used to meet these conditions.

2. When oil is being used, it only takes fifteen minutes to start the plant and to be ready to turn out material. Then at the end of the day's run, the oil burners can be shut off before the last of the material is needed, so that the drum need not be rotated for more than ten to fifteen minutes after the last batch has gone through the mixer. Again, if for any reason it becomes necessary to shut down the plant temporarily or suddenly, the burners can be shut off instantly and the fire is stopped, eliminating the danger of burning material and warping the drum, as is the case with a coal fire, where the fires have to be either heavily banked or drawn out on the ground, meaning considerable loss of time and labor.

3. Oil burners are of particular value when the requirements for material are intermittent, as is so often the case where work is being done at a distance, and where a number of teams or trucks will come for material at once, and then not for some time, or where the character of the work is such that it is only necessary to operate the plant for a day, or even for a few hours at a time. On account of being able to so quickly regulate the flame, it is practically impossible to either burn the materials or to bulge the drum.

The approximate cost of the two-unit, portable asphalt plant is $7,250, which includes two kettles and all necessary piping and the asphalt pump already described. The principal dimensions of this plant are as follows:

| | |
|---|---|
| Total height set up | 20′ 6″ |
| Shipping height | 11′ 1″ |
| Extreme length | 33′ 0″ |
| Height to mixer platform | 7′ 3″ |
| Gauge of wheels | 7′ 8″ |
| Wheel base | 17′ 6″ |
| Width of mixer platform | 9′ 2¾″ |
| Drum | 10′ 4″ |
| Engine | 26 horse power |

THREE-UNIT PORTABLE PLANTS.

The Iroquois Works also manufactures their portable plants in the three-unit type, which are the same in general design as the two-unit plant, which has been described, excepting that the boiler and engine are omitted from the frame of the plant unit. The three-unit plant is built in two sizes with guaranteed capacities of 800 square yards and 1,250 square yards of finished two-inch standard sheet asphalt topping surface per ten-hour day, with proportionately higher capacities of binder course, asphaltic concrete, or Topeka mixture. In the case of the eight hundred square yard plant, the omission of the boiler and engine cuts the wheel base of this size plant down to 11 feet and 8 inches, and considerably decreases the weight of this unit. While the same size dryer drum is used in the 800 square yard, three-unit plant as that in the two-unit plant described, the dryer drum in the 1,250 square yard plant is 14 feet long by four feet diameter. This increases by approximately four feet the wheel base and overall length of the 1,250 square yard plant, making the wheel base 15 feet 8 inches.

In the three-unit type of plant, the first unit consists of the cold material elevator, the heating drum, the hot material elevator, the screen, sand and stone storage bin, sand and stone weighing box on scales, asphalt weighing bucket, mixer, etc., all mounted on one truck on four wheels. The second unit consists of one or more asphalt melting kettles, while the third unit is the source of power—portable boiler and engine, traction engine or other power—by means of which the first unit may be belt driven. On account of the shorter wheel base, the frame of the three-unit plant is lighter than on the two-unit plant, and consists of twelve-inch, 20½-pound channels.

With the boiler and engine mounted on its own truck, there is considerably less weight in any one unit, making the three-unit plant more easily portable than the two-unit type. It is, therefore, especially recommended for highway paving and other contracts where frequent moving of the plant, as the work progresses, is more desirable than long hauls of the hot mixture.

The Iroquois Works is prepared to furnish portable, steam-heated melting kettles for use with their portable plants, in capacities of two thousand gallons, three thousand gallons, and four thousand gallons, the recommended capacity, as previously stated, depending on the kind of asphalt used and whether or not it is to be fluxed at the plant. In the latter case sufficient kettle capacity is usually required for a full day's output of the plant with only one charging of the kettles. This company also furnishes portable boilers with engines for driving the three-unit type plants. The boilers have sufficient capacity to both drive the plant and furnish the required amount of steam for the steam-heated kettles and to agitate the asphalt cement as it is being melted.

The following authentic data has been received from a well-known user of one of these plants, and will be of considerable interest. The capacity ratings on these plants are all conservative, and experience has shown that purchasers have no difficulty in exceeding the capacity guarantees as given by the manufacturers by twenty-five, and often as much as fifty per cent. The data given herewith is presented with the consent of both the manufacturer and the owner, Booth and Flinn, Ltd., Pittsburgh, Pa.

*Type of Plant.*—Iroquois Portable, Two-Unit, Model of 1915. Guaranteed capacity, 800 yards per day.

*Time of Operation.*—From the middle of August, 1915, to the third of December of the same year, not taking into consideration an unusual number of bad days, upon which it was impossible to operate the plant.

*Total Output.*—The total output during the time named above was 4,665 tons of mixture.

*Mixture Used.*—Asphaltic concrete composed of fifty to sixty per cent of one-inch-and-a-quarter stone down to dust, plus thirty per cent. sand, plus six to ten per cent. of asphaltic

(*Continued on page* 44.)

# Annual Meeting of the National Paving Brick Manufacturers' Association and Conference and Demonstration on Monolithic Brick Construction

THE following paragraphs will present a brief summary of the proceedings of the annual meeting of the National Paving Brick Manufacturers' Association, held at the Hotel Deming, Terre Haute, Ind., on October 5, The meeting was purely a business one, of interest only to the members of the association, but the conference on and demonstration of monolithic brick country road construction on the following day at Paris, Illinois, was of great general interest, and was attended by several hundred of the best-known paving and highway engineers of this country.

The demonstration of the actual laying of this comparatively new type of brick pavement was naturally the drawing card, and it was, without exception, the most complete and instructive demonstration of the kind that has ever been given before a body of highway engineers and authorities on paving. The comment heard on all sides following the actual laying of about eight hundred yards of the pavement showed that a deep impression had been made, and this impression was materially deepened after they had ridden over some fifteen miles of the same type of pavement that had been constructed last year and this year. The absence of longitudinal cracks, now so common in most brick pavements laid under the old methods, was particularly noted and commented upon, and the general impression of those present at the demonstration and the inspection trip following it, was that the right path has at last been taken in the construction, not only of brick country roads, but brick city streets as well.

The pavement was laid strictly in accordance with the new specifications for this type of pavement that have just been issued by the National Paving Brick Manufacturers' Association, and no better description of the method could be written than the actual publication of the specifications, which we are doing in this article. These specifications, well illustrated, step by step, will be found following the account of the meeting and conference.

The concrete was mixed in a No. 12 Austin Cube Mixer, and placed within Heltzel steel side forms, which were lined up several hundred feet ahead of the mixer. A Marsh-Capron grout mixer was used for grouting. The template used was a Parrish Monolithic Template, manufactured at Paris, Illinois, by the contractor, Allan Jay Parrish.

The pilgrimage of more than four hundred engineers, officials, and men of technical pursuits to Paris, Illinois, on October 6, bore testimony to the keen interest that surrounds any step toward more permanent road improvements. The magnet that drew this throng was the monolithic brick pavement, which has so amply advertised Paris and Edgar County to the highway world within the last twelve months.

This pavement was closely inspected. Its merits were tested by an auto drive in which the citizens of Paris acted as hosts. But the most absorbing interest centered around the demonstration of actual paving methods in laying a twelve-foot, curbless, monolithic pavement on a rural road some two miles north of the business section of Paris. This demonstration was a climax to a two-day session of the National Paving Brick Manufacturers' Association. The major part of this session took place at Terre Haute, Indiana, seventeen miles from Paris.

The session of the association revealed a state of harmonious satisfaction in the brick fraternity, with undiluted optimism for the future of the brick pavement and the industry at large. This spirit was evidenced in the re-election of the entire list of officers for the association, as follows:

President, C. C. Blair, of the Bessemer Limestone Company, Youngstown, Ohio.

Vice President, J. W. Robb, of the Clinton Paving Brick Company, Clinton, Indiana.

Treasurer, C. C. Barr, of the Barr Clay Company, Streator, Illinois.

Secretary, Will P. Blair, of Cleveland.

Guests of the association assembled throughout October 5, which was the first day of the conference, affording opportunity for the informal interchange of views and experiences. The headquarters of the conference were at the Hotel Deming, whose commodious facilities were taxed to the utmost by the size of the throng.

The outdoor program commenced Friday morning with a trip of inspection over a few of Terre Haute's more conspicuous examples of the paving art. Among these was South Sixth Street, whose brick pavement was laid in 1891, and whose excellent condition is a testimony to the permanency of conscientious brick construction, even under conditions that are not the most recent. South Sixth Street is one of the busiest streets of the city, and at the same time is favored for high-grade residences. It has withstood the test of twenty-five years and presents a present-day condition that appeals to a paving connoisseur.

North Seventh Street was exhibited as an example of the latest type of monolithic brick construction, proving that the gain in durability through this method sacrifices none of the smoothness obtainable under the older method.

The trip to Paris was made at nine in the morning, five interurban cars and several automobiles being used to convey the throng. The point chosen for the demonstration was a strip of the Chicago highway adjacent to the city water works reservoir. It was not a "staged" demonstration, but a part of the actual contract for improvement of this road, now being carried out by Contractor Allan J. Parrish, of Paris, Illinois, under the general supervision of Engineer W. T. Blackburn. These two men have won deserved note in the paving world for the excellence and economy of the monolithic pavement laid in Edgar County in 1915. While the monolithic idea has been advocated repeatedly through several decades the credit for working out mechanical details and gaining deserved recognition for the merits of this kind of brick pavement undoubtedly belongs to these two men. Naturally they shared largely in the pride which this day brought to Paris and to Edgar County.

"Brick roads have done so much for Paris that we cannot compare life in the old days of muck roads with life in this city as it is to-day," asserted Mayor W. H. Hoff in handing the city's keys to the incoming delegation.

The visitors saw not merely the demonstration of each step in the paving process—the laying of the concrete base, the operation of a double template, which leveled the concrete and spread a dry mix of mortar; the rapid laying and grouting of the brick surface; but they witnessed a spectacle of structural efficiency that won the compliments of all and the envy of some. Contractor Parrish reported at the end of the day that he had laid eight hundred yards of pavement in spite of the unavoidable interference of visitors who pried into every detail of the work and fairly overran the job. He also reported more than one offer to buy his organization, just as it stood.

The paving demonstration was followed by a barbecue lunch in the water works par. Quarters of beef and mutton were roasted over an open fire and converted into sizeable sandwiches for the hungry highway horde. Coffee and dill pickles completed the menu. After a group picture had been taken, the crowd was taken in automobiles, furnished by the public-spirited citizens of Paris, and two or three hours devoted to a trip of inspection over the various types of roads to be found in the vicinity of Paris. The main thoroughfares have been improved with brick to the north, east, and west, and the paving is in excellent condition, scarcely a flaw being noticed in the entire journey.

The return to Terre Haute was made by trolley and the entire assemblage sat down to a banquet served in the Hotel Deming. After six excellent courses had been deftly served and valiantly consumed, Toastmaster Paul Bogart inaugurated the speaking program of the evening.

Joe L. Long, Editor of the *Road Maker,* drew some apt illustrations of the way in which improved highways annihilate distance. He asserted that any farmer living on a paved road within eleven miles of a business center was really closer to town, from the standpoint of time, than is the average citizen of a large town, like Chicago, who must encounter innumerable delays and travel considerable distance in going from point to point in the city.

Spencer F. Ball, President of the Chamber of Commerce, extended Terre Haute's welcome. He felt confident of the good intentions embodied in brick, because, he said, hell could not be paved successfully with a material better calculated to withstand fire and rough treatment.

Clinton Cowan, Highway Commissioner of Ohio, voiced a liberal attitude toward all of the various efforts to solve the problems of highway construction, believing that widespread encouragement would do most in developing greater and greater excellence.

An account of Illinois economy in the matter of concrete base was given by W. W. Marr, Chief Engineer of the Illinois Highway Department. He expressed the belief that monolithic construction opened the way for the use of bases of as little as one inch in thickness, or less, with rigidity equal to that obtained with greater expenditure of material under the old methods. In other words, Illinois is working for the maximum mileage of brick roads consistent with durability.

Prof. Leonard S. Smith, of the University of Wisconsin, took the college term, "team play," for his theme. He pointed out the advantage of co-operation between men of varied pursuits, whose objects, upon analysis, prove to be closely related. Team play between the public, the official, the engineer, the contractor, and the workman is requisite to a thorough-going highway program, he declared. He paid a fervent tribute to the breadth of policy of the Brick Association and Secretary Blair for adopting a policy that was truly educational rather than merely promotional.

Prof. Ira O. Baker, Professor of Civil Engineering at the University of Illinois, likewise complimented the association upon its disinterested measures in the direction of better construction and its candor toward highway questions. He felt certain that all present had been benefited by the opportunities of the day.

The program was closed by President C. C. Blair, of the association, who thanked his honored guests for their words of tribute, and voiced the pleasure of his association in no uncertain terms over the success of the occasion and the gratifying interest shown by the engineering profession.

## Specifications for the Construction of Vitrified Brick Country Roads

### Green Concrete Foundation Type Cement Grout Filler

ITEM I. UNDERDRAINAGE.

Section 1. Adequate underdrainage shall be provided to remove rapidly all water from the subgrade of the roadway to a depth of not less than eighteen (18) inches below the base of the brick road. All underdrainage facilities shall be completed and approved by the engineer prior to laying the artificial foundation.

Note: The function of surface and underdrainage in road construction is that of stabilizing subgrade conditions by making it dry. The property of soil to sustain loads is dependent upon its character, and its degree of density, which should be uniform. The presence of water in the subgrade seriously vitiates the development of the full capacity of the soil as a load-bearing element.

The engineer should examine carefully the proposed location of the roadway, noting all evidences of underground flow or seepage, and if the effects therefrom will come within the limit of eighteen (18) inches below the base of the brick road, he should prepare special plans and specifications to insure a rapid removal of the water in accordance with the provisions of this section.

Roads are subjected to the wear and tear of traffic and to the destructive forces of nature. Thorough drainage, minimizing the danger of injury from the latter source, aids the pavement in resisting the former, and an initial expenditure for thorough drainage is justified in keeping with the hazards that await unless this feature is thoroughly cared for by preventive measures.

ITEM II.—GRADING.

Section 1. The roadway and approaches thereto herein provided to be improved, shall be graded to such lines, subgrades, and cross-sections that, when rolled, the finished surface of the subgrade shall conform to that shown in the plans and specifications.

Section 2. All vegetable matter, and soft, spongy, earth, muck, or quicksand, which will not compact by rolling, shall be removed to such depths as directed by the engineer and replaced with suitable material.

Section 3. Earth in embankment shall be applied in layers



Paris, Illinois—Middle Springfield Road. Laying brick.

not exceeding six (6) inches in depth, and each layer shall be thoroughly rolled and compacted before successive layers are applied. All vegetable matter, and soft, spongy earth, muck, or quicksand, which will not compact by rolling, shall be excluded from embankment as provided for earth in excavation.

Section 4. The roller used in compacting the subgrade shall be of the self-propelling type, weighing not more than ten (10) tons.

Rolling shall continue until the subgrade is thoroughly compacted. Any depressions in the surface thereof created by rolling, shall be filled with suitable material. The process of rolling shall then be repeated until the subgrade is of uniform density, with a smooth and even surface.

Section 5. No earth from excavation or embankment shall be deposited against or upon any material, brick or stone, sand or gravel, to be used in the improvement. Such materials shall be so placed and protected that they will be uninjured by travel or grading operations.



Paris, Illinois—Middle Springfield Road, showing brick without cement filler

Section 6. Immediately before the artificial foundation is laid, the surface of the subgrade shall be tested, and if not found as required, it shall be corrected to conform to the true subgrade in plans and specifications.

ITEM III.—CURBING.

Note: In the construction of country roads of the Green Concrete Foundation Type, no curbing is necessary, therefore refer-

ences thereto, which would logically have place under Item 3 are entirely omitted.

In exceptional cases, however, but more in the nature of retaining walls or for surface water disposal where steep grades are involved, sections of curbs may be found advantageous.

### Item IV.—Concrete.

Section 1. Cement used shall meet the requirements of the Standard Specifications for Portland Cement of the American Society for Testing Materials, adopted August 16, 1909, with amendments and additions thereto adopted by the said society.

Section 2. Fine aggregate shall consist of clean sand or of screenings from hard, durable rock or gravel of igneous or silicious origin, uniformly graded in grain size, one hundred (100) per cent. of which shall pass a one-quarter (¼) inch sieve mesh. It shall be free from soft, friable material, shale or slate, and vegetable or other organic matter, and shall not contain clay in excess of five (5) per cent.

Section 3. Fine aggregate containing more than five (5) per cent. of clay, or that in which individual grains are coated with fine material, shall not be used.

Section 4. Coarse aggregate shall consist of sound gravel, crushed stone, vitrified clay or slag.

Section 5. Gravel used as the coarse aggregate shall be composed of hard, durable stone, uniformly graded between such sizes that one hundred (100) per cent. will pass a one and one-half (1½) inch, and be retained upon a one-quarter (¼) inch revolving screen. It shall be clean, free from soft, friable material, vegetable or other organic matter.

Section 6. Stone used as the coarse aggregate shall be of igneous, quartzitic, or calcareous origin, and both hard and durable. It shall be uniformly graded in size between that which will pass a one and one-half (1½) inch, and be retained upon a one-quarter (¼) inch revolving screen. It shall be clean, and free from dust.

Section 7. Slag or vitrified clay used as the coarse aggregate shall be hard and sound, and of such composition that the specific gravity shall be not less than 2.3. They shall be clean and free from dust, and of the sizes provided in Section 6 for broken stone.

Section 8. The cement, coarse and fine aggregate, or if gravel be used, the combined aggregates, shall be measured separately and mixed in such proportions that the resulting concrete shall contain fine aggregate amounting to fifty (50) per cent. of the volume of the coarse aggregate, and that seven



**Paris, Illinois—Middle Springfield Road. Applying first coat of cement filler**

(7) cubic feet of concrete in place shall contain one (1) sack of cement or ninety-four (94) pounds.

Section 9. Water used in mixing the concrete shall be clean, free from oils, acids, alkalies, and vegetable matter.

Section 10. The ingredients of the concrete shall be thoroughly mixed, sufficient water being added to obtain the desired consistency, and the mixing continued until the materials are uniformly distributed, and each particle of the fine aggregate is thoroughly coated with cement and each particle of coarse aggregate is thoroughly coated with mortar. A batch concrete mixer shall be used, the materials shall be proportioned dry, and then deposited in the mixer all at the same time. The mixer shall produce a concrete of uniform consistency and color, with the stones thoroughly mixed with the water, sand, and cement.

Note: It is impossible to write definite specifications for mixing concrete, particularly to fix its proper consistency. At present the best evidence for determining the proper consistency is found in the nature of the green concrete in place. Certain facts, however, are definitely established.

With any given proportion of the aggregates to cement, the strongest concrete is obtained when the aggregates are uniformly distributed to form a homogeneous mass, coupled with the presence of sufficient water thoroughly admixed, to hydrate the cement, withal producing a concrete readily handled and placed without the necessity of tamping.



**Paris, Illinois—Middle Springfield Road, showing bricks removed from pavement**

These requirements prohibit the use of an excess of water, which reduces the adhesion of the cement to the fine aggregate, and in turn of the mortar to the coarse aggregate, and which furthermore produces a porous concrete upon the evaporation of the water simultaneous with the hardening of the concrete.

On the other hand, a lack of water is prohibited by the requirements of sufficient water to hydrate the cement, ease of handling and placing, and freedom from tamping.

In individual instances, the proper amount of water to be used in mixing depends upon the nature of the aggregates, their relative dampness when they enter the mixer, and the use to be made of the concrete. Thorough dry mixing of the ingredients is essential as well as thorough mixing after the water has been admitted.

Strict supervision of all the operations and factors involved, coupled with the exercise of sound judgment, are essential in securing the best results in mixing and placing concrete.

### Item V.—Concrete Foundation.

Section 1. The subgrade, if dry, shall be lightly sprinkled with water before placing the concrete.

Section 2. Concrete for the foundation shall be deposited, struck off, and finished to the depth of ..... inches, as provided in the plans and specifications, so that when complete, the surface shall be parallel to, and ..... inches below the grade of the finished roadway. The surface shall be smooth and uniformly finished, with the coarse aggregate thoroughly embedded in mortar. Concrete in place shall have been so mixed, deposited, and finished, that the coarse and fine aggregate shall be uniformly distributed throughout the mass (in the proportions provided in Item 4, Section 8.) The concrete shall be brought to the required surface smoothness, and condition for laying the brick thereon by adding thereto a thin coating of sand and cement.

Section 3. The sand and cement for the thin coating shall be of a quality equal to that used in the fine aggregate in the concrete. They shall be thoroughly mixed dry in advance in a mechanical batch mixer, in the proportion of one (1) part cement to three (3) parts of sand by volume. Mixing shall continue until the mass attains a uniform shade. Sufficient quantity shall be prepared at intervals in order that there shall be no interruption in preparing the surface of the concrete for brick laying.

Section 4. Steel forms shall be utilized to retain the concrete and brick and serve as guide rails for the template, and when so used shall be true to line and grade.

Section 5. The concrete shall be brought within the requirements of Section 2 by means of a double template which shall consist of a six (6) inch steel I beam in front and a six (6) inch steel channel or I beam to the rear, held in a rigid frame with the two members parallel, spaced two (2) feet from center to center, and shaped to conform to the cross-section of the roadway. The rear member shall be held in the frame with the bottom three-sixteenths (3-16) of an inch higher than that of the frame member. Rollers shall be attached to the frame which shall rest, when in use, upon the guide rails.

In shaping the concrete deposited from the mixer, it shall be thoroughly spaded, settled, and roughly surfaced immediately ahead of the double template. A sufficient amount of dry mixture for the thin coating shall be supplied continually between the framed templates so that in the forward movement, the rear template shall distribute the necessary film over the entire surface, producing the required smoothness.

Section 6. In cases where the use of the double-framed template is impracticable, the required surface shall be secured by templates or by hand luting.



**Paris, Illinois—Middle Springfield Road, showing brick pavement without curbing**

Note: By reason of the fact that the rear cutting edge of the double template is three-sixteenths (3-16) of an inch higher than the front cutting edge, the forward movement of the template, as described, performs two operations simultaneously, namely, that of striking off the concrete which has been deposited upon the subgrade, and spreading over its surface the three-sixteenths (3-16) of an inch film of the dry mixture, which being of equal quality of the mortar in the concrete becomes an integral part of the concrete.

Concrete of a consistency which will sustain the brick surface uniformly during the laying, rolling, and filling the joints, is a necessary prerequisite. It is equally necessary, too, that the green concrete shall be of a consistency affording a mortar surface which will insure a perfect adhesion of the brick.

The use of transverse joints in the surface or base of the roadway should not be permitted.

Section 7. The use of partially hardened mortar or concrete, remixed with water, is prohibited.

Section 8. No concrete shall be mixed or deposited when the air temperature is below thirty-two degrees F., unless during the mixing the aggregates shall be heated so that when placed, the temperature of the concrete shall be not less than sixty degrees F. The pavement shall then be protected by sufficient covering against freezing. In no event shall concrete be deposited upon a frozen subgrade.

### Item VI.—The Brick.

Section 1. Brick shall be evenly burned, thoroughly annealed, and uniform in texture. They shall be hard and tough, and when broken shall show a uniform fracture, free from marked laminations.

Section 2. Brick shall be provided with not less than two (2) nor more than four (4) projections on one side, which shall not extend more than one-quarter (¼) nor less than one-eighth (⅛) of an inch. If the edges of the brick are rounded, the radius shall not exceed three-sixteenths (3-16) of an inch.

Section 3. The standard size of vitrified paving brick shall be three and one-half (3½) inches in width, four (4) inches in depth, and eight and one-half (8½) inches in length. They shall have one reasonably straight face, and they shall not vary from these dimensions more than one-eighth (⅛) of an inch in width or depth, nor more than one-half (½) of an inch in length.

Section 4. The brick shall not lose of their weight more than ..... per cent. when subjected to the Rattler Test.

Section 5. The Rattler Test shall be conducted in accordance with the Standard Specifications for Paving Brick adopted by the American Society for Testing Materials in 1915.

Section 6. The contractor shall name the brands of the brick, with the prices respectively, upon which he submits bids.

### Item VII.—Brick Delivery.

Section 1. Brick shall be handled carefully and piled neatly outside the roadway in sufficient quantity to complete the brick surface. They shall be so protected that they will not become covered or spattered with earth, mud, or other debris.

### Item VIII.—Laying and Rolling the Brick.

Section 1. In delivering the brick from the piles for placement in the roadway, no wheeling in barrows will be allowed on the brick surface, but they should be carried on pallets or carriers, in such order that when delivered to the dropper, they will lie in such a position, that each brick in the regular operation of placing it upon the foundation as prepared, will bring the projections in the same direction and the better edge uppermost. Passing to and fro over the freshly-laid brick for deliveries to the dropper shall be upon boards laid for that purpose.

Section 2. All brick, when laid, shall be clean and kept clean and free from dirt and foreign matter until the pavement is completed.

Section 3. Upon the foundation as prepared, the brick shall be immediately laid with the better edge uppermost and the projections in one direction. Only whole brick shall be used, except as provided or by special direction of the engineer.

Alternate courses of brick shall be commenced with a one-half (½) brick, and all joints across the roadway shall be broken at least three (3) inches. Upon laying the brick, they shall immediately be batted in at the edge line, using fragments of brick in no case less than three (3) inches in length. The fractured end of cut or trimmed brick shall be turned toward the center of the roadway. Each course shall be laid true and even, transverse to the edge lines, and shall be closed and straightened by tapping lightly with a sledge on a four by four (4 x 4) inch timber, three (3) feet in length, provided with an upright handle. All the work of brick laying shall be done over the brick surface already laid.



**Paris, Illinois—Middle Springfield Road. Applying second coat of cement filler**

Section 4. Immediately after laying the brick, the surface of the road shall be swept and inspected. Brick not laid with the better face uppermost shall be turned over and those not meeting the specifications in Item 9 shall be removed and replaced by those acceptable. Brick slightly chipped, but otherwise good, shall be accepted.

Section 5. Surplus brick delivered shall be moved forward and used in the road. Rejected brick suitable for batting shall

be used therefor. All remaining brick shall be neatly piled at the side of the roadway.

Section 6. Immediately after the brick in the pavement have been inspected and the surface of the pavement swept clean, the pavement shall be rolled with a hand roller approximately thirty (30) inches long and twenty-four (24) inches in diameter, made in sections and filled with water, weighing not less than twenty (20) pounds per inch of length. The rolling should be kept close to the laying and continued until surface is smooth.

Section 7. Such portions of the roadway surface as are inaccessible to the roller shall be brought to the required surface by hand tamping, applied upon a two (2) inch board.

Section 8. Broken or otherwise injured brick shall be removed and replaced prior to the final rolling operation.

Section 9. The completed surface of the roadway shall conform to the true grade and cross section within the limits of one-quarter (¼) of an inch. Depressions exceeding the limit shall be corrected by removing and relaying the brick. The roadway shall be completed and made ready for grouting at all times within twenty-five (25) feet of the brick laying.

### Item IX.—Cement Grout Filler.

Section 1. The joints between the brick shall be completely filled with cement grout composed of one (1) part of cement to one and one-half (1½) parts of sand, measured by volume.

Section 2. Cement and water used in mixing the grout filler shall conform to the specifications provided for the same under Item 4, Sections 1 and 9 respectively.

Section 3. Sand used in the grout filler shall consist of clean, sharp grains or of screenings from hard, durable rock or gravel of igneous or silicious origin. It shall be of such



**Paris, Illinois—Middle Springfield Road, showing the completed road**

sizes that one hundred (100) per cent. will pass a No. 12 sieve, not more than forty (40) per cent. will pass a No. 50 sieve, nor more than six (6) per cent. will pass a No. 100 sieve. It shall be free from soft, friable material, shale or slate, vegetable or other organic matter, and shall not contain clay in excess of five (5) per cent.

Section 4. Sand containing more than five (5) per cent. of clay, or that in which individual grains are coated with fine material, shall not be used.

Section 5. Mortar briquettes, composed of one (1) part cement to three (3) parts of the above fine aggregate, when tested in tension, shall develop a strength not less than one hundred and twenty (120) per cent. of that shown by the same test applied to similar briquettes of the same age, composed of one (1) part of the same cement to three (3) parts of Standard Ottawa Sand. Tests shall conform to the Standard Tension Tests of Cement Mortar of the American Society for Testing Materials.

Section 6. The sides and ends of the brick in the joints shall be thoroughly wet by sprinkling immediately preceding the application of the filler.

Section 7. Sand and cement in the proportions specified shall be mixed dry in a mechanical batch mixer until the mass attains a uniform shade. Sufficient quantity shall be so mixed that a continuous supply will be available during the operation of grouting.

Section 8. The cement grout filler, applied by hand, shall be prepared in a specially devised box recommended by the National Paving Brick Manufacturers' Association.

Section 9. A small batch not more than two (2) cubic feet, of the prepared dry mixture, shall then be placed in the box and sufficient water added and mixed to produce the consistency of mortar. More water shall then be gradually added, continuing the operation of mixing, until the whole reaches such consistency that it will readily flow to the bottom of the joints without separation of the ingredients.

Section 10. The filler shall be removed from the box to the surface of the roadway with scoops. Sufficient filler shall be applied until the joints are filled. Surplus filler shall be swept immediately into the joints, making certain that they are completely filled to the bottom. During the process of removing the filler, that remaining in the box shall be constantly agitated, in order that the filler be maintained in the proportion required.

Section 11. After the first application of the filler has been made and sufficient time has elapsed to allow it to settle in the joints without reaching its initial hardening, a second application shall be mixed and spread in the manner provided for the first, with the exception that less water shall be used in mixing, producing a filler of somewhat thicker consistency. The filler shall be swept immediately into the joints until they are completely filled by means of squeeges having rubber edges, which shall be worked at an angle thereto.

Section 12. Successive applications of the filler shall be made as provided until the joints remain completely filled, flush with surface of the roadway.

Section 13. When a mechanical grout mixer is used in preparing and applying the filler, it shall be of the batch type, self-contained and portable, and shall be of such construction and operation that the surface of the roadway shall not become splashed with oil or water. The prepared filler shall be delivered from the mixer to the roadway surface in such manner that there shall be no separation of the cement and sand in transit or in place.

Section 14. The requirements for the application of the filler shall be the same in the use of a mechanical grout mixer as those provided in the use of the hand-mixing box.

Section 15. The contractor shall provide metal strips, one-sixteenth (1-16) of an inch in thickness, six (6) inches in depth, and three (3) feet in length, which shall be inserted in a transverse joint in the brick before closing the grouting of each work interval in order that the grouting shall end in a vertical joint. The strips shall remain in place until the filler has developed its initial hardening and be removed before the final hardening shall have occurred. At the end of each working period the concrete foundation, brick laying, and grouting shall end in a single transverse line, at which line work shall be resumed as provided.

Section 16. After the roadway has been inspected and approved, and sufficient time has elapsed to avoid injury to the filler, a protective covering of sand or earth not less than one (1) inch in depth shall be spread upon the road. This shall be kept wet for a period of not less than four (4) days.

Section 17. The brick roadway shall be closed to traffic for a period of not less than fifteen (15) days after its completion.

* * *

Hundreds of millions of dollars are invested in the manufacture of automobiles and motor trucks. Up to this date the manufacturers of automobiles have been able to sell their product without it being necessary to make a survey of the highways, good or bad, which are to be traveled by the automobiles, and the purchasers of the automobiles have been sufferers from bad road conditions—roads made bad by poor construction and kept bad by a lack of maintenance and repair—but just now manufacturers of motor trucks, especially of the heavy type, are finding it positively necessary to inquire of the prospective purchaser the kind of a road he intends to use the truck on, for the kind of a road on which he expects to use the truck will have much to do with the life of the truck.

# Annual Meeting of the American Society of Municipal Improvements

THE Twenty-third Annual Meeting of the American Society of Municipal Improvements, held at the Robert Treat Hotel, Newark, New Jersey, October 9-13, inclusive, was the best attended and the most successful meeting that was ever held by this well-known society. The program was long—far too long for any meeting, and fully one-third of it was devoted to paving, street cleaning, and other subjects that are of interest to the highway engineer. Sessions were held at night, and it was far after midnight on two occasions before the sessions were finally adjourned.

Monday, the opening day of the meeting, was devoted to a series of meetings of the Sub-Committee on Standard Specifications, all of which were open to all, and an opportunity was given to all material interests to enter into the discussions, which is not possible, excepting on rare occasions as a special courtesy, when the reports of the Committee on Standard Specifications are being presented to the society. These meetings were held in the following order, following each other, so that those desiring to attend more than one, or all, would have that opportunity.

Wood block paving, E. R. Dutton, chairman.
Brick paving, E. H. Christ, chairman.
Bituminous paving, Linn White, chairman.
Asphalt paving, Francis P. Smith, chairman.
Concrete paving, W. J. Hardee, chairman.
Stone block paving, H. H. Schmidt, chairman.
Broken stone and gravel roads, A. H. Blanchard, chairman.
Sewers, E. J. Fort, chairman.

The General Committee on Standard Specifications, of which George W. Tillson, Consulting Engineer to the President of the Borough of Brooklyn, is chairman, met in the evening and formulated its report, which was presented to the society later in the week.

The morning session on Tuesday was preceded by a meeting of the Executive Committee. The formal session was opened with an address of welcome by Mayor Thomas L. Raymond, of Newark, the response being delivered by President A. F. Macallum, of the society. Then followed the reports of the various officers and committees, all of which showed the society to be in a flourishing condition. The remainder of the morning session was devoted to the presentation of a number of technical papers, none of which were of interest to highway engineers. The report of the Special Committee on Standard Tests for Bituminous Materials, of which Prof. Arthur H. Blanchard is chairman, was presented at this session. Included in this report was a letter that had been sent out by this committee to a large number of chemists and paving authorities who have been prominently identified with work in bituminous materials. It explained the work that is being done by this committee, its plans, etc., and asked that those receiving the letters send to the chairman of the committee such statements and information as they considered should be covered in the specifications for bituminous cements to be used in the construction of bituminous pavements, as well as any other information which they might have which would be of general interest. Many replies were received to this letter, and much valuable information was secured for the consideration of the committee, which then submitted to the members of the society certain conclusions that had been reached by the committee.

The first of these conclusions was that, in the opinion of the committee, based on its present knowledge of the subject and conditions, that the determination of paraffin in paving specifications does not and cannot serve any useful purpose. The committee also stated in its report that it was of the opinion that specifications for bituminous cements for paving purposes should cover the following properties:

1. Proper consistency. This should be determined by the penetration, the melting point, by float or viscosity test, or by some other test to be devised.

2. Proper binding qualities. No agreement was reached by the committee as to the tests to be adopted for determining these properties.

3. Stability, including retention of physical and chemical properties. This is to be determined as follows:

For asphalt—By the loss on heating and
The consistency of the residue, or
On other tests to be devised.
For tars— By the distillation test and
The consistency of the residue, or
On other tests to be devised.

The Special Committee on Standard Tests for Bituminous Materials also reported that it believed that when a bituminous cement is combined with the mineral aggregate, the resulting mixture should possess toughness, resistance to abrasion, malleability, and stability, and that certain tests should, in justice to the bitumens, be devised to cover the measure of each of these properties.

Tuesday afternoon was devoted to an automobile trip through the city of Newark and over the magnificent county park boulevard system of Essex County, up into the Orange Mountains to the Cedar Grove Reservoir, where an inspection of the water works was made, and where light refreshments were served.

Owing to the length of the program, several of the papers on Tuesday evening were read merely by title, including only the ones that were of interest to highway engineers. These were the Report of the Committee on City Planning, by G. A. Parker, Chairman, Superintendent of Parks, Hartford, Conn., and the Report of the Committee on Streets and Sidewalks Design, E. A. Kingsley, Chairman, Consulting Engineer, San Antonio, Texas. George C. Warren, President of Warren Brothers Company, Boston, Mass., gave a most entertaining lecture, well illustrated with stereopticon views, on "Highway Construction in the Northwest," showing what has been done along the Columbia River Highway and other scenic routes of that section of the country.

The most important business of the morning session on Wednesday was the election of officers. The Nominating Committee, which had been appointed the previous day, made its report, and the convention instructed the secretary to cast a unanimous ballot for the following officers for the ensuing year:

President, Norman S. Sprague, Chief Engineer of the Bureau of Engineering, Department of Public Works, Pittsburgh, Pa.

First Vice President, E. R. Conant, Chief Engineer of the City of Savannah, Ga.

Second Vice President, George H. Norton, City Engineer of Buffalo, New York.

Third Vice President, R. Keith Compton, Chief Engineer of the Paving Commission of Baltimore, Md.

Secretary, Charles Carroll Brown, Consulting Engineer, Indianapolis, Ind.

Treasurer, F. J. Cellarius, Consulting Engineer, Dayton, Ohio.

The report of the Committee on the Selection of the Place for the Next Meeting was then presented, and New Orleans, La., was the place selected, which met with the almost unanimous approval of those present.

There were a large number of papers scheduled for presentation at the morning and afternoon sessions on Wednesday, including several that had been held over from the preceding sessions on Tuesday, but many of these were merely read by title. Many of these papers are of great importance and interest, and the best of them will be published in early issues of Better Roads and Streets.

The evening was given over to the annual banquet, which this year was tendered to the society by the city of Newark, and which was an elaborate affair. A number of excellent talks and some good entertainment was the feature following the banquet.

Thursday morning there was a short session, but a most important one for the highway official. On another page of this issue of Better Roads and Streets will be found the

complete report of the Committee on Street Paving, on Present Practice Regarding the Replacement of Cuts in Pavements, by Horace Andrews, Chairman, and Consulting Engineer, Albany, New York. This report, on a subject of the utmost importance, is the most complete and most instructive report of the kind that has ever been prepared. It contains data on a large number of cities, showing in considerable detail the work that has been and is being done regarding the regulation of this rapidly growing evil, and will be found to be of more than passing interest.

At ten-thirty, the entire delegation of members and guests, boarded a special train for an inspection trip of the new Port Newark Terminal, after which a private steamer, furnished by the city of Newark, was boarded, and the party taken on a trip of five hours through Newark Bay, around and through New York harbor, and up both the North and East rivers, affording an excellent view of New York City. Lunch and refreshments were served on the steamer, and the party returned about six o'clock. This, it is well worth mentioning, was one of the most pleasing and enjoyable trips that the members of the society have ever been taken on at any of the annual meetings.

A number of papers had been programmed for Thursday evening, but after the meeting was called to order it was decided to first have presented the Report of the Committee on Standard Specifications, of which George W. Tillson is chairman. It is well that this action was taken, as several bitter fights developed over the asphalt specifications and the attempt to eliminate Bitulithic from the standard specifications, and it was long after midnight before the meeting adjourned, with the final decisions held over until the session of the following morning. The fights were the most bitter that the writer, who has attended scores of technical and engineering society meetings, has ever witnessed, and the least said about them the better, as such things should never be permitted to occur in a meeting.

The meeting closed at noon on Friday after several abstracts of papers had been read, and the remainder of the papers read by title. A number of the authors were not present, and the attendance was comparatively small, owing to the fact that many of those in attendance at the meeting were over in New York attending the meeting of the street-cleaning and refuse-disposal officials.

The registration list this year at the meetings of the American Society of Municipal Improvements was the largest in the history of the society, and about forty new members were enrolled.

## *Report of the Committee on Street Paving, on Present Practice Regarding Replacement of Cuts in Pavements

THE Committee of Street Paving has prepared its report bearing in mind that technical literature is now teeming with papers relative to the subject of street and road building, while the transactions of our society will this year contain much that is important relative to methods that are new or are advancements on former well-known means of road improvement.

Great difficulty confronts the modern road builder who is called upon to produce road surfaces that will be able to answer the requirements of traffic with horse-drawn vehicles and at the same time be suitable to withstand the strongly destructive action of motor vehicles, especially the very heavy motor trucks of various kinds that are becoming increasingly more common. Much remains to be done before any definite answer can be given to questions relative to lasting qualities and to economy of construction and maintenance.

Your committee has left to the individual writers of papers on road construction the discussion of matters connected with the new discoveries or improved methods, and has taken up the one subject of a proper repair to the street surface when the street is cut into for underground work, and a new foundation and a resurfacing become necessary on that account. As viewed by your committee, the subject of municipal improvements, strictly speaking, does not apply to road building and repairing outside the boundaries of cities and incorporated villages. Within these municipalities there are always many underground constructions, such as sewers, water mains, telephone and telegraph wires, etc., which are the means of bringing to the street departments the peculiar problems of making a repair not called for by any ordinary wear from traffic.

Many of the members of our society will readily recall instances where cuttings have been made in good street pavements that could easily have been avoided by careful planning in advance of the paving work. Responsibility for sewers and water pipes generally rests upon city officials and these attempt to have all pipe laying precede paving operations. The other underground construction is not so easily controlled by the city and it is worthy of remark that in Chicago there has, within the last five or six years, been in operation a board of underground work public utilities. To quote from *Engineering News* (July 20, 1916), "The object and work of this board is to save the city pavements from avoidable openings." The cooperation of public utility corporations to this end is most earnestly to be desired as here is a case where most manifestly the "ounce of prevention is worth a pound of cure."

When a cutting into a pavement is made, the repair usually involves making a foundation for the pavement by careful back-filling that shall be capable of holding up the pavement to the same level as before removal, or by bridging with reinforced or extra thick concrete the place that has been disturbed, thus depending entirely upon the sustaining power of the adjoining foundation. In this latter method the back-filling of trenches acts merely as a species of bracing to prevent the adjacent soil from being undermined and disturbed, and as a centering to give support to the concrete, a support that will soon vanish with the slightest settlement of the back-filling. This bridging of trenches is comparatively a new method. Dependence upon the supporting power of back-filling at the present time is more customary than the bridging, and it seems desirable to consider both methods of repair as well as other factors connected with the whole subject of proper repair.

To obtain light upon the questions involved, your committee prepared a series of questions, a copy of which is appended to this report, and your secretary caused these questions to be submitted to a large number of cities throughout the United States and Canada. So much of importance has been obtained from the replies to the questions, that a brief abstract of the answers from those who have replied is appended to our report, while the full replies are available through our secretary. The thanks of the committee are expressed to those who have, with public spirit, with generous expenditure of thought, and with sacrifice of time, furnished answers to our inquiries.

The persons who received the questions were first asked whether their repairs were satisfacotry to themselves. A good many did not reply to this question, but implied in most cases that they were unsatisfactory, while fully a third of those answering stated candidly that their repairs were not satisfactory.

Considering first the matter of back-filling, it had seemed to the committee that the very laborious task of replacing the back-filling might be lightened by proper power ramming, and an effort was made to get statistics relative to this matter. It appears that power-ramming is very little used by the city authorities, though the public utility companies make more use of power ramming, apparently. Columbia, South Carolina, states that power ramming was used and it was not found satisfactory. A request for further information regarding the reasons for this reply was answered by Mr. John McNeal, the city engineer, as follows:

"The tamping machine with which this city experimented was a lightweight machine, operated by a small gasoline engine. We found that the weight of the tamper was too light to give satisfactory results, and also that the machine required not only a capable man to direct its operation, but also that it was more expensive than hand tamping. We find that hand tamping, under proper supervision, will give satisfactory results, and, while we are using reinforced concrete slabs over back-filled trenches excavated on paved streets, the supervision of the back-filling of the trench is by no means neglected on account of this construction. The same careful supervision is given these trenches that would be given them without the concrete slab."

*This report was presented as given herewith at the Annual Meeting of the American Society of Municipal Improvements at Newark, N. J., October 10th to 13th, inclusive.

As to flushing the back-filling in order to obtain better consolidation, the replies are worthy of careful consideration. The general opinion is decidedly in favor of this procedure when the soil is sufficiently pervious to enable the water to drain away quickly, otherwise the flushing is very injurious and settling may continue for a year or even for many years before the surplus water will have passed entirely out from the back-filled material. Regarding laboratory experiments as to the drainage power of various soils, interesting information is given by John R. Haswell, Drainage Engineer, United States Department of Agriculture, in *Engineering News* for August 3, 1916, page 213.

Of course, if power tamping is to be attempted, water flushing cannot be used, but only a slight moistening may be permissible. Most of the power tamping seems to be in such work as filling under railroad ties and around pipes. The only extensive power-tamped back-filling brought to the attention of your committee is that between the retaining walls of the Connecting Railroad's bridge at Hell Gate near New York (see *Engineering News,* January 13, 1916, p. 68, lines 7-15). Mr. G. Lindenthal, the chief engineer of the East River Division of the New York Connecting Railroad, writes in response to a letter of inquiry from your committee:

"I take pleasure to give you herewith some additional information on the compacted earth fill as used for our embankments between retaining walls.

"The material used was largely sand and gravel with some loam, and was well compacted in its natural state, standing with almost vertical slope.

"This material was spread between the retaining walls in layers twelve inches thick. It was then compacted with Ingersoll pneumatic back-fill tampers. The twelve inches of loose material compacted to about nine inches.

"The volume of packed material in the fill is only about one-half per cent. greater than the volume of the same material in its natural state before excavation. Water was used freely in tamping. The fill has been placed in the summer and fall of 1914, and so far no appreciable settlement of the fill has been observed."

A clause of the specification is as follows:

"Materials for filling shall be deposited by spreading evenly in layers not to exceed twelve inches in thickness and having a crown of twelve inches at the center between the retaining walls. The layers to be thoroughly rammed and compacted with rammers weighing not less than twenty pounds per square foot of area. Water shall be used in the compacting as directed by the engineer."

Attention may be called to the replies from Pasadena, California, where the use of a fifteen-ton roller is referred to, for consolidating the material in the back-fill. This is the only place reporting this method of consolidation. In very many places the crossing of the trench by pipes, water, gas, and sewer, which would be much in jeopardy from the use of a heavy roller, would make that means of packing trenches inadvisable.

It is the consensus of opinion from those furnishing replies that all of the repair work should be done by the municipality through its own trained workmen, but in some cities exception has been made in favor of those public utilities which are so much in the habit of making cuttings that they may keep a force of trained men for this purpose, but even then it is urged that strict city supervision should not be dispensed with. Much of the trouble found with repairs is attributed to the class of workmen who make the cuttings, back-fill, and repairs to concrete and pavement. Skilled men paid by the day by the municipality and employed exclusively on repair work are preferable to all others for insuring uniformity of excellence in cutting-repairs.

It is the practice in every case reporting, not to keep any account of the original order or arrangement of stone blocks or bricks, but they are replaced in accordance with the judgment of the paver.

In replacing stone block pavement, the personal observation of the committee has shown that frequently the blocks are put back with joints wider than those originally existing. Many stones for which no place can again be found, are therefore removed from the street.

Most of the cities replying state that joints in block pavements are filled with cement grout, but in some cases where traffic is heavy, a bituminous grouting that will enable traffic to pass over the pavement very soon, has taken the place of the slow-setting cement grout at repaired places.

The matter of withholding traffic from recently repaired works seems to be a fruitful source of trouble, and it is evident from the replies from some cities that the original care in getting a thorough set to both the concrete base and the cement grouting, by allowing a period of some ten days (see proceedings of 1915 convention, pp. 402 and 455) to elapse before turning on the traffic, is not taken with their repaired work. In some instances it is thought that by covering the newly-made repair with earth to the depth of a few inches, traffic may safely be permitted and that setting of concrete and grout will then go on unimpaired. It is very doubtful whether a shorter time of setting than seven to ten days will enable any repair to approach the original pavement in its solidity and general excellence.

Many cities now seem to have concrete foundations for their pavements and it is well known that thoroughly set concrete foundation will support a large area of pavement even where the earth base is weak in spots. This strength of the concrete foundation has led some engineers to follow the practice of bridging any soft place, such as that made by digging a trench, with concrete that will carry the load to the adjacent firm soil. Such concrete is either made of unusual thickness, or, more generally, is reinforced with steel (see report of Am. Soc. Mun. Impts. for 1915, p. 407, and answers to inquiries appended hereto).

Judging from the answers received, the reinforced concrete bridging gives very satisfactory results and enables the surface of the replaced pavement to be brought to the same place as that of the adjacent pavement without "mounding up," as is so frequently done in the case where the support of the concrete base is either non-existent or has been destroyed.

In Buffalo, New York, brick or stone pavement is left a little higher to allow for compression of the cushion, but such compression is not more than one-fourth to one-half inch, and is a usual allowance in all new work that is to be consolidated by rolling or ramming. A possible disadvantage of the concrete bridging is referred to in the reply from Toledo, Ohio, where mention is made of "the roar that is apt to result from rapidly-moving, steel-tired vehicles passing over the hollow space beneath the paving."

It seems a rather unfortunate solution of the problem of street repair of the nature now being considered, that the earth foundation should be abandoned as of no use in supporting the replaced pavement, but there is good reason for advocating the use of a bridging of the soft space resulting from a cutting, with reinforced concrete.

The cost of a series of relayings of pavement can hardly be less than that of a good, continuous beam of reinforced concrete, while the constant annoyance from interrupted traffic, etc., at each repair is hardly measurable in money value. Moreover, repeated relayings are highly injurious to block pavements, due to the chipping of the corners and breakages.

Attention is called to the reply from Mr. Fancy, relative to work in the Borough of Queens, New York City, through the courtesy of Olmsted Brothers, where it is stated that "the concrete roads seem to be the easiest to repair and on account of the many service connections to the houses, that is, sewer, water, and gas, it is thought that the concrete road was the best for development work."

It may be found true that a repair can be made to a pavement made entirely of concrete, both as to base and surface, by comparatively unskilled labor, that will compare favorably with repairs where skilled labor is needed in block-paved streets. Delay must be occasioned to traffic owing to the necessity of proper setting of the concrete, but the time of blocking of traffic would be somewhat lessened in the concrete paved street from that required where cement grout must also have time to set.

With bituminous pavements, as is well known, excellent repairs can be made where a concrete foundation is used and the usual precautions are taken to insure its proper setting, but a reinforcement of the concrete would seem very advisable in the case of recently filled trenches, even where all possible precaution has been taken with the back-filling.

It seems to your committee that with ordinary methods of ramming the back-filling, it is doubtful whether a pavement

can be laid over any recently-opened trench as well or as economically as is possible with a strong reinforced foundation. Of course, an opportunity must be afforded this reinforced foundation for as thorough setting as in the case of new pavement.

Power ramming does not yet seem to have been thoroughly developed and made as economically possible as it may reasonably be expected to become when more inventive effort is directed to its need. Certainly the heavy labor of tamping back-filling may well be supplemented by proper use of power, as in so many other branches of industry.

### Questions Relative to Street Pavements Necessitated by Cutting for Gas, Water, or Sewer Pipe, Etc., Where Pavement Surrounding Cut is in Good Condition.

Are your street repairs satisfactory to you, and if not, in what respect can they be improved?

Replies to questions are sought for the information of the Committee on Street Paving of the American Society of Municipal Improvements.

The information obtained will be presented to the society in the committees's report, as an aid to formulation of proper methods of repair, enabling the entire paved area of a city to be preserved in good and uniformly satisfactory condition.

Answers to the questions are sought in narrative form, but following the order of the questions and replying as nearly to the questions as may be practicable, while adding any facts that may lead to better knowledge and better work in respect to repairs.

#### BACK-FILLING.

1. What is the character of the soil removed in making cuts for pipe-laying repairs?
2. How is soil replaced and consolidated? Have you used power-ramming at any time?
3. How large a percentage of the material removed is returned?
4. Is back-filling at any time made of material brought to replace soil dug out, and, if so, is resulting work improved to a noticeable extent, and at what cost?
5. Is flushing of back-filling with large quantities of water permitted and advocated, if so, what is nature of soil so flushed, and does back-filling subsequently settle and carry the pavement with it, and for how long a period does settling continue?

#### WORKMEN MAKING REPAIRS.

6. Is the back-filling of trenches made with careful supervision as to tamping, etc.?
7. Are repairs made by workmen specially trained?
8. Are the workmen under city pay, and if so, on what basis are they paid?
9. Are repairs made by plumbers, gas or water companies or others merely acting under general municipal regulations?

#### STONE-BLOCK AND BRICK PAVEMENT WITH SAND OR CONCRETE FOUNDATIONS.

10. In replacing blocks is care taken to preserve the order originally obtaining, or are blocks removed without sorting and then replaced according to judgment of the paver, and with no attempt to preserve original order?
11. Are all the blocks that have been removed, returned?
12. How are the joints filled after paving?
13. Is the repaving brought to the original surface or level, or is the repaving mounded up to allow for settling of trenches?
14. How many relayings of pavement are required before all settling disappears?
15. Have you any brick pavement without concrete foundation, if so, with what are the joints filled? If bricks are broken in removing, are any broken bricks returned in the relaying?
16. Is concrete foundation reinforced at any time after repairs, if so, how is it done? Is any of material of old concrete used in making concrete foundation for repaired pavement?
17. For how long a time is the concrete allowed to set before pavement is replaced?
18. Is a sand cushion used, or a bedding of cement mortar?
19. How are the joints of the repaired pavement filled?
20. For how long a time is the repaired pavement blocked from traffic? Is blocking effectual and the repaired pavement actually preserved from all traffic while blocked?

#### REPAIRS TO BITUMINOUS OR CONCRETE PAVEMENTS.

21. What precautions are taken to secure a good bond with the existing pavement at the sides of the cut?
22. Are any portions of the old pavement that have been removed, used again in making the repair?

#### WINTER REPAIRS.

23. If a cutting has to be made while the ground is frozen, what kind of back-filling and repaving is done?

Abstract of replies from cities to questions regarding repairs to cuttings in street pavements.

The cities are arranged in accordance with their population.

**Buffalo, New York. George H. Norton, May 22, 1916. Population, 423,715.**

Repairs are in general fairly satisfactory, although they might be improved by better control over the work done by plumbers. Franchise work on repairs is under supervision, but on plumbers' work the inspection is only nominal as the inspector usually visits the trench to see the pipe placed and then again after the trench is filled.

In two-thirds of the city there is heavy clay, not easily replaced, in the remainder of the city there is sand, loam, and rock, which give comparatively little trouble. There is hand ramming only. In outlying streets the back-filling is often flooded where it is not expected to lay a pavement in some time. Except with clay all the back-filling can be replaced. Sometimes new material is brought and this costs $1. to $1.25 per cubic yard.

Flushing is only effective in sandy soils or in some rock trench where the finer material is washed down into the coarser rock. Settlement in a trench may continue for a number of years, but must take place after the first winter.

Some of the labor is trained and the city does comparatively little of this excepting in the repair of its sewers and water mains where city labor is paid for at the rate of twenty-five cents per hour. Concrete foundation is generally replaced by city men or by franchise companies, or by contractor under maintenance bond. Old blocks are not sorted but replaced in repaving by judgment of the paver. With bricks, where bricks removed have no lugs, adhering mortar makes it impossible to follow the old course and occasionally a course must be broken to fill in. Cement filler in general use, but on heavily traveled streets a bituminous filler is used as better than keeping traffic off the cement filler. Brick or stone is left a little higher to allow for settlement, not of the trench but rather that due to bedding in the cushion, the general rule is on block stone from one-fourth to one-half inch and about one-fourth inch in brick and asphalt, the asphalt left high for compression allowance.

In exceptional cases reinforcing has been used but not enough to establish any general rule. On large trenches we hold the concrete bed from seven to ten days before placing the brick or stone but on small cuts the brick or stone are replaced immediately over the soft concrete and usually covered with a layer of gravel or sand. Cement mortar bedding has been used in exceptional cases, in important trenches the grout is held from traffic for seven to ten days as stated, but where traffic is heavy, bituminous filler is used, or the protecting cover of earth, to give as good protection as possible. Old foundation of natural cement is well broken up, screened, and old stone usually used for new concrete, and this same plan used in repaving streets. In freezing weather frozen material is discarded and filling with cinders and on heavy traffic streets the cut is temporarily repaved with old common stone, placed in the sand or cinders until permanent repairs can be made.

**Toronto, Canada. R. C. Harris, May 25, 1916. Population, 376,538.**

The soil is generally from clay to gravel, E. & W. portions being all sand and gravel with a good deal of clay in central and northern portions. Hand ramming in layers six inches deep. Power ramming has been experimented. Percentage of material replaced, unknown. Only rarely has soil to be brought to replace material dug out. Water flushing is permitted in previous soils with excellent results, and a great deal of difficulty in subsequent settlement has been avoided in this way.

Water flushing has been attempted in streets, unimproved, where a number of years previously sewer had been laid and it was thought that final settlement had been attained, yet with the water flushing the trenches settled. No repairs are made to the pavements by plumbers or any of the public utilities companies, although the companies may make the cut and after having installed their service attend to the back-filling. Block order originally obtaining is not preserved.

Joints are filled with cement grout except where travel is heavy and then paving pitch is used for jointing. In nearly every instance we can cement-grout the joints in the brick pavements. We endeavor to have the surface level with the adjoining pavement. At times repairs settle and require renewing, it is exceptional to repair twice, however. Bricks on sand have not often been disturbed but where this has been done we have used concrete base for replaced bricks. No reinforcing, or using of old concrete materials. Seven days allowed for hardening of concrete replaced.

then bricks are relaid and grouted and three or four days more allowed before traffic is put on. Bituminous pavement repairs do not present as much difficulty, we cut back the surface to get a clean, perpendicular edge, paint with liquid asphalt and the asphalt mixture is then replaced to the thickness of the surrounding pavement and rolled. Old asphalt has been reheated and mixed with fresh A. C., and then used for repairs, but this practice has not been continued generally, owing to inadequate plant. In winter cuts the soil taken out is replaced and the pavement repair is not made until such time as the frost has come out of the ground and proper consolidation has taken place.

**Boro of Queens, New York City. C. B. Fancy. Population, 224,041.**

(This reply is from the Chief Engineer of the Sage Foundation Homes Company and relates only to the work of that company.)

The soil is yellow clay four feet to fifteen feet deep, over sand. In some cases there are boulders, not over one cubic yard, in some places hardpan. No power ramming. In every case we have returned 100 per cent. of the material removed. Improper material, such as loam or vegetable matter, is replaced by sandy clay, the work is thereby improved and the extra cost is simply that of material and hauling from twenty cents to thirty cents a cubic yard. We water-flush wherever we can and have not noticed any case where the pavement has settled. Back-fill is made by our own workmen, except with gas trenches. Specially trained workmen, paid by the hour. Gas company does careful work but the Sage Company allows six months before replacing the pavement. Have had no repairs to stone or brick pavements. Concrete pavement foundations are not reinforced. Repairs in concrete pavement, slopes are made to sides, care being taken that no concrete is fractured along the edges, these edges are painted with neat cement and the concrete then poured flush with the old pavement. I do not know of any better way of repairing the streets, so they are necessarily satisfactory to me. The concrete roads seem to be the easiest to repair. On account of the many service connections to the houses, that is, sewer, water, and gas, concrete roads are thought the best for development work.

**Kansas City, Missouri. L. R. Ash, May 17, 1916. Population 248,381.**

Soil generally clay, stone, and shale. Tamping by hand only. Flushing used. Ninety per cent. of material replaced. With rock-cutting new material is required to some extent. Sewer cuts back-filled have a large quantity of water in flushing the back-fill, even if the soil is clay. Back-filling generally settles and carries the pavement with it, settling continues for long periods. No specially trained men for repairs. An inspector under city pay is on the work. Repairs are made by plumbers, companies, etc. Blocks are removed without sorting and replaced by the judgment of the paver. Sometimes not all of the blocks removed are returned. Joints generally filled with cement grout, almost universal of late. Pavement is brought to the original surface. As a rule at least two repavings are required before settling disappears. Concrete foundation is never reinforced at any time. Old concrete bases are frequently broken up and the material cleaned and used again in new pavement or in repairing pavement. Concrete is allowed one week to set before pavement is replaced. Sand cushion is used and the joints are filled with cement grout. An attempt is made to block traffic for one week at least, the blocking as a rule is effectual in new work but in the case of repairs the blocking is not effectual and the traffic is generally on the repaired portions of the street within a day or two after the repairs are made. Old asphalt removed is not used again in making repairs. Winter cuts are filled with old, frozen material and warmer weather awaited before the final back-fill and repair.

**Louisville, Kentucky. D. R. Lyman. Population, 223,938.**

The soil is a compact yellow clay, a loamy clay, or pure sand. No power tamping has been used but with clay hand tamping is used and with sand or loamy soil water flushing is used. Ninety-five per cent. of clay is returned and with sand about ninety-eight per cent. Water flushing is more satisfactory for sand than tamping but some trouble is met with from settling which sometimes continues for a period of from four to six weeks. Joints are filled with Portland cement grout. Pavement is brought to the original level. Usually not more than two repavings are required but if found necessary more repavings are used. Concrete foundation is not reinforced. Materials in the old concrete are used in making concrete foundation after breaking and forking.

Wherever possible the pavement is replaced the same day as it is removed. Pavement is blocked from traffic for two days, but is heavily covered with sand to absorb shocks after the barricades are removed. The blocking is effectual.

**Toledo, Ohio. G. A. Crayton. Population, 168,497.**

In the majority of cases the repairs are not satisfactory for the reason that the earth supporting the paving is not settled all that it will, therefore, after its settlement there is nothing to support the pavement except the strength of the paving itself. The obvious is (1) See that the earth is compacted all that it ever will be before the paving is relayed; or (2) Reinforce the concrete base, if there be one, with steel, sufficiently to bridge over the trench, this latter method is objectionable on account of the roar that is apt to result from rapidly-moving, steel-tired vehicles passing over the hollowed space beneath the paving.

Flushing with large quantities of water is desirable, both as to cost and as to results, provided that the material being back-filled is of a sufficiently sandy character to allow the water to escape quickly, otherwise the water escapes but slowly and permits the paving to settle any way. If the ground is nearly impervious better results are obtained with tamping and slight moistening of the back-fill.

**Memphis, Tennessee. J. H. Weatherford. Population, 131,105.**

The soil is yellow clay. Repairs are largely handled, in fact, almost exclusively, by the city, and while the results are not as good as we might like, they, generally speaking, are very satisfactory.

The yellow clay is really ideal for back-filling. Never use power ramming. We generally replace all material except where very large pipes take too much space, and with small pipes we sometimes have to haul new material extra.

Flushing of the back-fill is generally not permitted and has not proved satisfactory, but in a great many cases we back-fill one to two feet above the top of a pipe and puddle this, then throw in dry dirt to take up the excess of the water and replace the balance of the dirt by tamping.

Back-filling is generally done by workmen thoroughly conversant with that kind of work. All repairs are made by the city forces. Inability to remove the old grouting makes it necessary to use practically all new material—blocks, etc. If grout has been used originally we grout with repairs. Repaving is not mounded up, but the original surface used. There is no reinforcing, but the old material is put into the back-fill and new concrete is then used. A week is allowed for the concrete to set, but if immediate use is necessary bituminous concrete is used. An endeavor is made to block off rejointed pavement for a week, but this causes much trouble and grouted pavements are the source of much trouble.

**Spokane, Washington. Morton Macartney. Population, 104,402.**

The soil is generally rock and a gravelly soil mixed with loose rock. Soil that compacts most readily is preserved and material less desirable is hauled away. In solid rock from thirty-five per cent. to forty-five per cent. is thus wasted, in gravelly soil and rock from twenty per cent. to thirty-five per cent. We have no requirement that makes it necessary for a contractor to fill with other material than that taken from his trench. Little water flushing is done, and where it is done the soil and back-fill subsequently settles a considerable distance on each side of the trench, and this settling usually continues for a year after the trench has been back-filled. The city supervises the back-fill whether it has done the excavation or not. City operates its own paving plant and does the bulk of paving repair work. The city has little stone block or brick that has been disturbed by excavation. The usual methods of repair are used with bituminous pavements, but no portion of the old pavement removed is used in these new repairs. No frozen ground is allowed to be used in back-fill in winter and pavement is not replaced till warm weather prevails.

**Hartford, Connecticut. Leon F. Peck. Population, 98,915.**

Soil is clay. Hand tamping is used with the clay cut into fine pieces and tamped, sometimes mixed with sand and crushed stone. Power tamping has been used by one of the public-service corporations. Sand and crushed stone brought to replace material removed give good results. Some supervision only with the back-filling, which is done by ordinary labor, and pavement repairs are made by city men or city contractor. In macadam, some repairs are made by the city men and some by those making the cut. With stone blocks no attempt is made to preserve the original order of the blocks. Granite blocks are grouted with cement. The pavement is left flush with the adjacent pavement. Generally, temporary pavement is first used for a few weeks. There is one block of brick pavement now covered with sheet asphalt, settlements are continually taking place. No reinforcement is used. Old concrete is not used for the final repairs. Concrete is allowed to set from one day to two weeks. Where pavement is replaced the traffic is diverted for a few days. There is no cement bedding for blocks. Cement grout is used for refilling repaved joints and five days blocking is attempted, but blocking is not always effectual. No old material is used in repairs to bituminous or concrete pavements.

For winter repairs we back-fill with crushed stone and sand. Cement concrete is laid temporarily, flush with the surface.

**Hamilton, Ontario, Canada. A. F. Macallum. Population, 81,969.**

Repairs are not quite satisfactory. We have decided to remove the concrete base for twelve inches on each side of the excavation and use reinforcement in replacing concrete.

Soil is gravel and sand, shale, red and blue clay, and sandy loam. Hand tamping is used, power tamping was used in 1914. Frequently all of the material removed is replaced, no new material is brought. Flushing is permitted in sandy loam soil where the water drains away quickly. If so used with clay the soil remains spongy for a considerable time. Back-filling is done by the municipal companies doing the excavation, but the foundation is replaced by the district foremen of the city and the cost is charged to the company or contractor. With bricks on concrete, settling is allowed for two or three days before bricks are replaced, and for ten days or two weeks after the bricks are replaced. Dry cement mortar cushion and cement grout used. New material is preferred for concrete. Winter cut remain unpaved till spring and at all times are allowed to remain open for some time.

**Wilkes-Barre, Pennsylvania. B. K. Finch. Population, 67,105.**

Soil is loam. No power ramming. Ninety per cent. of the material is returned in back-filling. Repairs are made by workmen specially trained and under city pay at rates of $2 to $3.50 per day. All joints in blocks are sand filled. Relaying once, sometimes two or three times. Pavement repairs are not blocked at all from traffic. There are forty-eight miles of paved streets, all asphalt and

brick. Concrete base is cut back to leave a shoulder and this helps to keep the cut from settling.

**Erie, Pennsylvania. B. E. Briggs, City Engineer. Population, 66, 525.**

All repairs to cuts are made by the city, but permits are issued to corporations under bond. Temporary repairs are made, by replacing old materials soon after the trench is closed by roughly replacing stone, brick, or sheet asphalt, the latter being cut out in small squares. Work is performed by unskilled labor. All trenches are supposed to be well tamped. In case a temporary pavement settles, as it usually does once or twice, the city force places additional filling and relays the bricks, the cost of which is added for final repairs on the bill. Final repairs are made by skilled labor and made to conform to the material and grade of the surrounding pavement. Freshly mixed material is always used in repairing a sheet asphalt pavement. For old asphalt pavements a cheap mixture is used consisting of three-fifths binder and two-fifths topping. Cement grouted pavements are protected for one day by fencing, then covered by three inches of soft earth or sand saturated with water and then opened to traffic. After over ten years of experience in maintaining pavements I am convinced that the most satisfactory plan is for the city to make its own repairs.

**Charleston, South Carolina. J. H. Dingle. Population, 58,833.**

The repairs are not yet absolutely satisfactory, although much improved since the adoption of a regulation that all back-filling must be done by city employees. The soil is sand, and sand with a small amount of clay over old marshes that have been filled with sand and mud. Hand ramming is used, no power. All material is generally returned, with small pipes. With bad material mud for back-filling is brought to replace the same. Large water-flushing is not advocated, but dampening of the material in layers is practiced. City hands do the back-fill under city foremen. The same men are employed, so as to become experts in the work. There is a charge made to plumbers, etc., by rate of cubic yards removed. The order of blocks is not preserved. Repaving is left slightly high, or "stiff," as the pavers call it. Generally after two relayings about a year apart the settling disappears. In some cases the first repaving holds. Concrete foundation is not reinforced in making repairs and old stuff is not used again. Concrete is allowed three days setting before wearing surface is put on, the repaired pavement is opened to traffic as soon as completed.

**Pawtucket, Rhode Island. Geo. A. Carpenter. Population, 51,622.**

Repairs are unsatisfactory. Engineering department has no oversight or jurisdiction in the matter, and all cuts and repairs in the pavements are made by those cutting, individuals, etc. The back-filling is ordinarily made by a laborer and has no supervision by the city. There is no stone pavement on a concrete foundation and very little brick pavement in the city. The whole question of street repairs is in a rather unsatisfactory condition.

**Binghampton, New York. J. A. Giles. Population, 48,443.**

Soil is mostly gravel, in some places is hardpan. The back-filling is in nine-inch layers and hand tamping only used. About ninety per cent. of the material is returned. In hardpan regions the material removed is replaced by gas-house cinders for about three feet above the pipe at a cost of thirty cents for a yard and a half. Where gravel exists the flushing with a moderate amount of water is permitted. There are no noticeable settlings in the pavement for the reason that the old shoulder of the concrete base is cut back about nine inches and have used expanded metal extensively to reinforce the new base. There are no specially trained workmen and repairs are made by many parties. No attention is paid to sorting the blocks to keep the original order. Winter repairs are made with sand jointing, and this is replaced in warm weather. Pavement repairs are brought to the original surface. No old concrete is allowed in a new base. Concrete is blocked from traffic in summer for forty-eight hours, bricks are laid, grouted, barricaded for sufficient time and heavy bed of sand placed over it when traffic is resumed. In very cold weather, when the ground is frozen for two feet or over, the old material is allowed to be used if not frozen in lumps, to within two feet of the surface, cutting is then brought to grade with cinders and allowed to remain in that condition until spring conditions allow new pavement to be laid. There is some difficulty in keeping this cinder fill from being thrown out by automobiles.

**Pasadena, California. E. P. Dewey. Population, 30,291.**

Soil is black adobe and brown clay to sand, gravel and boulders. Except in clay and adobe, soil is replaced with a generous amount of water, heaped over the ditch, allowed to partially dry out and then made compact by the use of a fifteen-ton roller, or by driving a loaded cart along the trench. In case of clay or adobe hand tamping with a little water is required. Power ramming has been used but discarded because the road roller appears to give equally good results at less than half the time and expense. With flooding great care is necessary to avoid softening the ground beneath the uncut paving, causing settlement along the sides of the ditch. The subject is one of great importance and probably has never yet been satisfactorily settled. There is no careful supervision, the parties making the trench throw back the earth, flood the same and leave it well rounded up. After allowing time for partial drying out the street department attends to final rolling and replacing of pavement. We have no stone block and very little brick pavement, and that has never yet been broken into. There is no frost.

**Norristown, Pennsylvania. S. Cameron Corson. Population, 27,875.**

Repairs are not satisfactory. Hand ramming only is used in six-inch layers, no flooding is permitted. I have had considerable experience with ditches that have been flooded or flushed, and in every instance, excepting sand, the result has been that the ditch was never ready for repairing, it was always too soft and spongy; concrete replaced had to be torn up and the pavement relaid. We now try making a slab of concrete to bridge over the trench space. If such a concrete slab is used, extending from six inches to one foot over the edge of the side of the trench the pavement may be laid on the same cushion level, if not, a slight crown is permissible. I do not approve of such crowning, as it usually makes two holes, one on either side of the raised crown. Trolley cars should be kept off the streets, passengers being transferred by check, in which case the results are better than when the cars are allowed to pass over the new work.

**Columbia, South Carolina. John McNeal. Population, 26,319.**

The soil is sand and clay. Back-fill consolidated by hand ramming and flushing, power ramming was tried and proved unsatisfactory. Practically all the material removed is returned. A small quantity of water is used and tamping then used. Large quantities of water are apt to form tunnels in the trench.

In repaving trenches over excavations on paved streets the concrete foundation is removed for a distance of about twelve inches on either side of the excavated trench, and after the back-filling is completed the concrete base is replaced with a reinforced concrete slab of sufficient strength to carry the surface load in case of settlement of the trench. This plan, while a trifle expensive, has been found most satisfactory, no settlement having appeared over trenches resurfaced in this way. The original order of blocks before removal is preserved. The repaving is brought to the original surface, as it will not settle. Concrete is allowed seven days to set.

**Moline, Illinois. Lyle Payton. Population, 24,199.**

Yellow clay soil, which can be readily replaced and with hand ramming only. Occasionally the refilling is with sand or cinders. Water flushing is not used, but tamping preferred. Special men who devote all their time to the work are employed; are employed by the city and none by plumbers, gas, or water companies. There are no surface pavements but brick and sheet asphalt, relaid to conform to the original surface of street. In general we have no trouble with settlement. Brick pavement without concrete foundation is relaid on sand and joints filled with sand. If occasion demands the concrete foundation is reinforced with No. 29 wire mesh.

**Richmond, Indiana. F. R. Charles, Population, 22,324.**

Repairs are very seldom satisfactory. It is extremely difficult or almost impossible to replace a pavement as good as before disturbance. Soil is clay, loam, gravel, sand, and rock. In all but the rock we are generally able to replace all material removed. Occasionally, in case of rock, new material is used for back-fill instead of the rock, with good results. Flushing with water is permitted and in most cases is satisfactory. Even after replacing all material taken out trenches will often settle further, and I have had cases where this settlement developed after six or seven days. Men trained for the work are employed by the water company but not by others, and with these the results are not so good. Water works company has a power tamper which is an advantage in some localities, although even after thorough tamping flushing with water will cause further settlement. Repairs are not made by municipal men. No special effort is taken to maintain the original arrangements of bricks. Cement grout is used in filling joints even with pavements that have soft fillers on original pavement. We prefer not to round up the pavement, in case of further settlement it must be taken up and relaid. This is frequently done at least once. In winter and in bad weather the trench is tamped and the bricks replaced temporarily, using a sand filler, until settlement is completed or weather conditions permit the final relaying. Concrete foundations have at least twenty-four hours set before laying bricks and the trench is preserved from traffic. In busy streets this is so difficult that we often protect it with two to twelve inches of clay and then allow the traffic to go over it.

**Waukegan, Illinois. M. J. Douthitt. Population, 16,069.**

Soil clay mostly, but some loam. Replaced by flooding with water, no ramming being ever used. About ninety per cent. of the material is replaced. In making a cut through pavement we refill with sand which cost about fifty cents per cubic yard. The flushing is good, however, and very little settlement occurs and that takes place within a year. Back-filling is usually by plumbers and is not satisfactory because of lack of inspection. No reinforced concrete ever used. About two days allowed for concrete to set before replacing the pavement and no blocking off from traffic, which is let on as soon as the sand filler is put on the bricks.

**Pittsburg, Kansas. L. E. Curfman. Population, 14,755.**

Clay soil. Hand tamping and all material removed is replaced. Flushing is only permitted on extensive works and does not give permanent results; time must be allowed for the settlement to occur, after which more material is added and tamped to bring the filling to grade. This is done before the pavement is replaced. Back filling is not carefully supervised, workmen are not in city pay and are not specially trained. Repairs are made by plumbers, companies, and others under city regulations. In relaying double-course brick pavements the two courses are kept separate and relaid as to original order of courses. Joints are filled with sand. City

ordinance requires the surface to be brought to the original level. We have more trouble in enforcing this provision than any other. Workmen, before the passage of the present ordinance, were accustomed to crown the pavement over the ditch to allow for settlement; some of them still persist in this practice. Reinforcement is used in special cases, such as wide or deep ditches; it is of triangular mesh. Concrete is also made thicker for the base than ordinary. The old concrete is only used in the back-filling. Concrete is allowed three days to set in ordinary weather, longer in cold weather, joints are filled with sand. Repaired pavement is kept from traffic for three days or longer by not replacing the bricks until the concrete is set, but piling them beside the trench they make an effectual blockade. The copy of the ordinance enclosed provides that the "filling shall be tamped thoroughly in two-inch layers with a tamper weighing not less than one pound per square inch of tamping surface."

Two-course brick work removed is replaced with a five-inch bed of concrete in place of underlying course of bricks, and this five-inch bed spans the trench and laps nine inches on each side.

**Farrell, Pennsylvania. J. Fred Thomas. Population About 10,000.**

Repairs are not satisfactory. They can be improved by making repairs under supervision of the street commissioner. Practically all of the material removed is replaced. Flushing of the back-fill with large quantities of water is permitted. Soil is clayey. It settles slightly after the flushing for a short period only. We have no concrete foundations.

**Creston, Iowa. T. S. DeLay. Population 6,924.**

Repairs are unsatisfactory and need intelligent supervision. The soil is clay. There is no power ramming and ninety per cent. of the material removed is returned. There is no careful supervision by the city, workmen are not specially trained and are not under city pay.

Repaired pavement is brought about to the original surface. "Repairing is usually done by plumbers the first time, then street commissioner takes a shot at it with no better results, after which the chuck hole remains without further attention."

**Frankfort, Indiana. R. H. Boynton. Population 3,634.**

Soil is clay with about one foot of loam on top. Water tamping formerly used but now discarded and hand tamping used. Eighty-five to ninety per cent. of material put back. Old material from trenches is the only material used in back-filling, but we are considering the use of gravel for water-works trenches. A new ordinance has been passed—a copy of which is enclosed—and better repair work is now hoped for. The joints are cement filled and the blocks are mounded, but as we lay a six-inch concrete slab, the edges of which are on the undisturbed earth, I believe the mounding will be better omitted and am experimenting with this at present. We have 4.83 miles of brick on sand foundation with cement grout filler and 1.52 miles of brick on sand with asphalt filler. In repaving we seldom use any of the old concrete base. I lay bricks directly in the fresh concrete and fill the joints with cement grout. The repairs are blocked from traffic for ten days or more.

In winter the earth is tamped into place to within one foot of the surface; the rest of the trench is filled with cinders, which are carefully tamped and dressed to fit the pavement surface. This cinder patch is retained until favorable weather for repaving.

**Longview, Texas. H. N. Roberts. Population 5,155.**

The soil is clay and sand and water-flushing is permitted. A concrete slab is used over trenches. It is thought that all repairs should be made by the city, and in future this will be done and a charge be made to the company or others opening the street. Repairs are brought to the same level as adjoining pavement and the reinforced concrete slab does not allow any settlement. In reinforcing we use one-half-inch bars six-inch between centers both ways, and five days are allowed for the concrete to set.

**Sewickley, Pennsylvania. E. E. Duff. Population, 4,479.**

The street repair work has not been satisfactory during the past, as no great degree of attention has been given to the work and every contractor or plumber has been allowed to relay the surface according to his own ideas with the consequence that holes have developed and considerable repatching has to be done at the boro's expense. We will not consider that repairs are satisfactorily made till they are all made by the municipality and to further this idea we have recently revised our permit forms, giving the contractors the option of allowing the boro to make the repairs at the contractor's expense, or else compelling the contractor to repair under a comparatively strict specification. We have a sandy soil in practically all cases, flooding is satisfactory and a ten-ton steam roller is used to compact the fill thoroughly after the same has been brought about four to six-inch above the street level. Work that has been repaired and in service about a year has not developed any holes. Ninety-five per cent. to one hundred per cent. of material removed is returned and occasionally we have to borrow dirt to complete the filling. The use of large quantities of water is advocated and no serious trouble has been met with from any settlement. Relaying of bricks is done by municipal men who are trained for that purpose, and it is advocated that all repairs be done by the municipality. We have not used any reinforcing in the concrete foundation in repair work, but have used a T-shaped section of plain concrete extending approximately six-inch into the excavation, below the concrete foundation of the street, and six-inch beyond the side walls of the excavation on each side. This concrete acts as a protection to the side walls and is heavy enough to carry the main load to the solid sub-base on the sides of the excavation. This concrete is made of one cement, two sand, and five broken stone, gravel, or crushed slag. No old concrete is relaid, twenty-four to forty-eight hours only allowed for concrete to set. We insist on twenty-four hours of effectual blocking, and while this is hardly long enough in some cases, we do not feel justified in blocking traffic for a longer period. A copy of permit to open the street is sent with attached coupons, etc. This permit allows the applicant the option of allowing the boro to make the repairs and agrees to pay for the same at cost plus ten per cent., which, of course, will relieve him of all responsibility. If the boro does the work a bill of materials is kept and contractor charged as shown on the back of the permit.

**Roselle Park, New Jersey. W. H. Luster.**

About ninety per cent. of the material removed is returned in back-filling. All repairs are made by the boro. We have no block pavement whatever.

* * *

## Street Cleaning by the Wet System

### By Gus H. Hanna, Formerly Superintendent of Streets, Cleveland, Ohio

NOTE—The following is a rather complete edited abstract of one of the most interesting papers that was presented at the Annual Meeting of the Society for Street Cleaning and Refuse Disposal of the United States and Canada, New York City, October 13, 1916.

IT has given me much pleasurable anticipation to be assigned to discuss the topic assigned me at a gathering of this kind. Street cleaning and the disposal of city wastes have presented stumbling blocks in the path of municipal progress for a majority of cities, and great credit attaches to the few on this continent who, through their fortunate or unfortunate contact with these problems, have been able to bring about the degree of progress which the past few years have witnessed.

I need not cite any dry statistics to convince this audience that city budget-makers have too frequently designated the street-cleaning department as a near relative to Kelly's goat, and have pruned its appropriation to the verge of criminality. I say criminality, because to impair the health of a city is criminal, especially where the cuts are made for the benefit of some boulevard in the suburbs that will enhance the value of land adjacent thereto, owned, in all probability, by some scheming real estate firm which is anxious to dispose of its possessions for a greatly-enhanced price at the expense of the tax-payers. Boulevards are a luxury not at all conducive to the comfort of the daily toiler unless he is the owner of an automobile. If the pruning knife must be used, I would suggest pruning the boulevards. The cleanliness of a community is a pretty accurate barometer of its health. I am not a physician and am not capable of adding anything to the controversy about the extent to which disease germs are transmitted by dust. I understand in a general way that there is less tendency to-day than there was a few years ago to attribute infection to dust-borne germs, although I think no one has gone so far as to deny that germ diseases in some instances are transmitted in dust. Further than this, I never heard of any one claiming that dust was a benefit to health, or cleanliness a menace. And leaving health out of the question, nobody wants filthy streets or dusty premises. Call it a mere sentiment if you will, but it is a sentiment that distinguishes the civilized man from his cave-dwelling ancestors.

And in relation to street cleaning cost, I want to point out that the most economical plan in which to perform the street-cleaning function is in the street. The same filth must be combatted somewhere, perhaps where it originates, perhaps where it is blown after lying neglected on the pavement. I recall a rhyme which appeared some years ago in an Ohio newspaper.

"We have a cheap and novel way
To clean a city street.
The summer sun beats down all day,
The breezes fan it as they play,
And blow the dust off neat.
The refuse of two thoroughfares
Is on our bric-a-brac and chairs
And in the food we eat."

The housewife is usually an advocate of municipal economy. Women tax-payers and women voters are usually strict contenders for low taxes, but who ever saw a woman that wanted the street cleaning neglected to save a few dollars? She knows that a dusty street means a dusty home, and that tedious hours

must be spent in cleaning furniture and rugs; that doors and windows must be kept closed when fresh air would be welcome; that dirty skirts mean laundry and cleaning bills; that her own time is the same as money, and that, where servants are employed, the cost of dusting and sweeping is an actual, tangible tax upon the family income. She knows, what any one knows upon reflection, that it is easier to collect filth upon a broad, level surface where it originates, than it is to wipe minute particles from vases and antique china, to extract it from rugs and draperies and efface it from carved furniture.

The merchant realizes the same thing when it is called to his attention. There is scarcely a mercantile concern in which the cleaning and dusting of stock is not a regular avenue of expense. There are many businesses that are obliged to hold periodical sales of goods soiled upon the shelves and counters, realizing from them considerably less than they cost. Any honestly-expended appropriation for street cleaning is a source of economy to such institutions.

During the past year we have had a frightful visitation of infantile paralysis. I will venture to say that a million or more of dollars has been spent in emergency measures to eliminate the disease. Yet it is noteworthy that the cases occur chiefly where children are forced by crowded conditions to play in the streets, and where streets are insufficiently cleaned, or perhaps so worn that they are uncleanable. Among the other offsets against the cost of clean pavements and cleanable pavements, I am asking you to consider the money spent to control this plague. I cannot ask you to offset the loss of babies' lives, for the tears of a mother, even though she is a tenement mother, is something that I will not ask you to appraise in cold dollars and cents.

I hope I have made it plain to you that tax expenditures are no different from other expenditures which individuals and firms are forced to make. The money comes out of the same pocket, and the only question to consider in relation to the disposal of street refuse is at what point it can be most effectually and economically, whether upon the street itself, or on our household effects and stocks of merchandise, or in the human respiratory tract and digestive system, disposed of and handled. Will we pay the street cleaner on one hand, or the hired girl, the stock clerk, the scrub woman, or the doctor on the other, making no allowance whatever for the labors of wives, for everybody knows that wives work for board and love.

Some plead for street-cleaning funds as a justifiable luxury. I contend for them as a means of saving money in the performance of what must be performed by some means, in any event.

I will not undertake a complete review of the various methods of street cleaning, most of which have their place in relation to the kind of pavement, traffic conditions, cost of labor, etc., all of which will be found to vary largely with the locality. My own experience, as Commissioner of Street Cleaning of the City of Cleveland, led emphatically to the conclusion that flushing, under favorable conditions was the cheapest and most effectual method of cleaning that could be devised. I collected statistics for some time as to the cost of cleaning various pavements by this method, and made some interesting discoveries, both as to the variation of cost on different surfaces and the relation of this variation in cost to the other charges that are customarily considered in choosing paving materials. I do not hesitate to assert that economy in cleaning is an item comparable in figures with economy in repairs, and should receive equal weight when the question of the material with which a street is to be paved is being given consideration. The preferred pavement must be of a non-adhesive substance, and must be free from crevices in which the dirt can lodge. The non-adhesive substances upon which my best results were obtained were vitrified brick, Belgian block, Medina block, or granite. I put brick first only because it is slightly smoother, and insist, for purposes of this comparison, that the other block materials enumerated must be suitably dressed, and that the filler, in every instance, must be a cement grout. A soft filler shrinks, wears, and disintegrates, leaving a crevice that cannot be cleaned by any method, and offers lodgment to moist filth which makes an ideal breeding place for disease germs.

The use of the flusher on a given street may vary from twice a week to a daily flushing, proportioned to the traffic. I would supplement flushing with a white-wing patrol system, in which the city is divided into sections with a suitable force of men assigned to each section. Every street should receive at least a daily visit from a man with a hand sweeper and a push-cart. Flushing saves the time and the energies of the sweeper, permitting him to work principally in the gutters, where the traffic is light, the entire accumulation of refuse can be removed in his hand cart, but for medium and heavily-traveled streets, his function will be merely to sweep the accumulated refuse into piles along the curb, which will then be collected by a dump wagon. The administrative test of a good street-cleaning superintendent lies in routing his flushers, his sweepers, and his wagons to get the maximum result with the minimum effort, and to avoid delays between the collection and removal of the wastes.

The handling of street wastes, garbage, and other refuse materials is the ensuing problem. My own strong preference is for the early incineration of all such materials. A city with ideal equipment and organization should incinerate its wastes daily. To be sure, certain exponents of thrift tell us that there are valuable substances contained in these wastes which can be extracted to the profit of the community. I have not yet been convinced that the pittance which communities realize from the sale of wastes afford a sufficient offset to the dangers entailed in handling these wastes for profit. Reduction means delay and much handling. Admitting that men can be hired to do this kind of work, I still think it is a kind of work which they should not be encouraged to do. The continual exposure to infection on the part of a few men means the continual exposure of the entire community to the danger of an epidemic. The plagues of Europe are not such distant history that we can afford to ignore the possibility of just such disasters here in America. We all remember a few years ago when garbage contracts in the smaller municipalities were customarily taken by hog-raisers, who undertook to convert municipal garbage, collected at a profit, into pork which could be sold for another profit. It was only when State veterinarians were compelled to kill thousands of diseased hogs and condemn other thousands of carcasses that the unprofitableness of this kind of profit became apparent. I think it is a fair type of the risks run by any community which fails to recognize in its substances, just what they are—dangerous poisons which are to be handled as little and destroyed as quickly as possible. Not merely the modern city, but the modern hotel, the modern factory, and the modern apartment house should have modern incinerating devices, adapted to their needs.

Such, briefly, are my sentiments upon two or three questions pertaining to the work of the members of this society. I wish that I could close with a fitting tribute to the dignity and importance of the membership represented here, and to the work in which you are engaged. To those who are engaged in sweeter-scented labors, the subject of street cleaning and waste disposal may be a nauseating one, but the obvious comment is that such a thing as a sweet-scented civilization was not possible until a portion of mankind had the knowledge, the will, and the consecration to devote its entire career to the elimination of that which was uncleanly. The physician who braves contagion that others may be well, the hero who goes to prison that others may be free, and the martyr who endures torment that others may have life, and have it more abundantly, are, as I see it, all of the great fraternity of self-denial, along with those who brave dirt that others may be clean. You could find more agreeable employment, perhaps, but none of greater importance to the community, and none, I am confident, that offers problems more worthy of a high order of intellect and devotion. May I wish you, individually and as a society, long life and continued usefulness.

* * *

## Prize Road Sign

Sometime ago the Illinois Highway Commission announced that a prize would be given for the best design submitted for a concrete road sign, to be used on State-aid roads. At a recent meeting of the Illinois State Highway Commission, the award was announced and was made to Walter H. Lienesh, Chief Engineer, Universal Concrete Products Company, 208 South LaSalle Street, Chicago, Illinois. Those interested in the design can procure facts, figures, and information from him.




AS LONG AS MIKE MAINTENANCE IS ON THE JOB YOU WILL HAVE GOOD ROADS

## State Convict Work in Oklahoma

The State Highway Department furnishes the following data in regard to the work of the various camps of State convicts in Oklahoma.

ATOKA COUNTY.

1. Number of convicts employed—30.
   a. Number of white men—none.
   b. Number of negroes—30.
   c. Number of Indians—None.
2. Number of days convicts have been employed—49.
3. Date work was commenced—July 15, 1916.
4. Percentage of sickness—2%.
5. General description of work done by convicts, including clearing and grubbing.
   a. Cubic yards of earth moved—5,000.
   b. Number of culverts or bridges constructed—1.
   c. Cubic yards of concrete mixed and placed—50.
   d. Number of miles of roadway cleared and grubbed—8.
   e. Other work done by convicts: Hauling rock and building wing walls.
6. Excess cost to county per man for feeding convicts—About 10 cents.
7. Total average cost per man to the county, including feed, transportation, etc.—About 12 cents.

The convicts in Atoka County are assisting in building rock retaining walls, removing stone, hauling materials, clearing and grubbing ahead of the grader, and helping generally in the construction of the Jefferson Highway, which is a National Highway passing through Atoka County from North to South, and includes about forty-two miles. In addition to the above work, the convicts in Atoka County are used in the building of concrete culverts. The extra cost to the county for maintenance of the convicts is about twelve cents per man per day. No State teams are used. The State furnishes one plow and all tools and camp equipment. The county furnishes four teams, two plows, one grader and engine, and one county foreman in connection with the foreman furnished by the State. The convicts appear to be satisfied with the work. They get along all right and obey the State foreman and guard.

B. C. MCCLEAREY,
County Engineer.

WAGONER COUNTY REPORT TO SEPTEMBER 23, 1916.

1. Number of convicts employed—30.
   a. Number of white men—30.
   b. Number of negroes—None.
   c. Number of Indians—None; cannot tell from looks.
2. Date work was commenced—April 19, 1916.
3. Number of days employed—110.
4. Percentage of sickness—About 3%; no record.
5. Road and culvert construction work: concrete culverts, rock and earth excavation, and fills.
   a. 8,155 cu. yds. earth, 1,500 cu. yds. rock.
   b. 28 concrete culverts and 2 small bridges.
   c. 402 cu. yds. concrete mixed and placed.
   d. No road cleared or grubbed.
   e. 10 miles machine graded road.
6. 15c per day per man, excess cost to county for feeding convicts.
7. 18c per day per man, total average cost to county.

The State has fourteen mules, two wagons, twelve wheelbarrows, and the necessary hand tools, such as axes, shovels, bars and picks, etc.

The county has four wagons, a plow, rooter and grader, both large and small.

The conduct of the men in general is good; the class of work is fair.

Most of the men are perfectly satisfied and prefer to stay in the camp and work on the roads rather than go to the "walls."

The treatment of the convicts by the guards is "A-1."

The work now is progressing more rapidly and the men are well fed.

I think perfect satisfaction in every respect.

Respectfully submitted.

H. H. HELLEN,
County Surveyor.

BRYAN COUNTY REPORT TO SEPTEMBER 12, 1916.

1. Number of convicts employed—30.
   a. White men—15.
   b. Indians—15.
   c. Negroes—None.
2. Date work commenced—April 18, 1916.
3. Number of days convicts have been employed—140.
4. Percentage of sickness—.0167%.
5. General description of work:
   a. Cu. yds. of earth moved—13,500.
   b. Number of culverts constructed, 14; bridges, 2.
   c. Cu. yds. of concrete mixed and placed—284.88.
   d. Number of miles of roadway cleared and grubbed—2, light.
   e. Other work done includes moving 9,658 lineal feet of fence; digging 210 lineal feet of ditch; work on engine; grading 475 stations; team grading, 64 stations.
6. Excess cost to county per man for feeding convicts, .1023 cents per day.
7. Total average cost per man per day, .1382 cents.

Teams furnished by State, seven; also three dump wagons, about ten or twelve Fresnos and slips, one small wheel grader, picks, shovels, etc.

The men seem to be satisfied, and are well treated by the guards.

Respectfully,

L. VARNER STINSON,
County Engineer.

POTTAWATTOMIE COUNTY REPORT TO SEPTEMBER 12, 1916.

1. Fifty convicts are employed, 48 negro and 2 white.
2. Work commenced April 10, outfit arrived April 3.
3. Convicts have been employed for 117 days, remainder of elapsed time being for Sundays, one-half Saturday rain, and holidays.
4. Have had four to five per cent. sickness.
5. Work has consisted of the grading of an earth road and the building of concrete culverts and bridges at all drainage crossings.
   a. 1,300 cu. yds. of earth have been moved.
   b. 10 culverts, 5 paved crossings, and 2⅛ bridges have been completed.
   c. 462 cu. yds. of concrete have been placed.
   d. 1 mile has been cleared and grubbed.
   e. 3½ miles of side ditches have been trimmed.
   f. 9 miles have been graded with traction engine.
6. Cost to the county for feed of prisoners has been, April 3 to June 15, inclusive, the total cost of such feed amounting to approximately $1,110. Cost, June 16 to August 26, inclusive, has been the difference or excess cost, which is $403.15. Average first period, 27.5 cents per man per day. Average second period, 10.9 cents per man per day.
7. The average total cost to the county has been 26 cents per man per day.

The State furnishes: 1 12-25 I. H. C. Tractor, 7 teams, 3 wagons, 10 slips, 4 Fresnos, 2 plows, 10 wheelbarrows, and miscellaneous small tools.

The county furnishes: 1 concrete mixer, 4 teams, 1 horse, 5 wagons, 2 slips, 1 plow, and some small tools.

The men are doing first-class work, their conduct is excellent for a negro, and they appear satisfied and contented with everything. There have been no attempts to escape.

L. L. WINANS,
County Engineer.

Report of work performed by convicts in Pittsburgh County for a period of six months, commencing March 1, 1916, to September 1, 1916.

Average number of convicts employed—55.
Average number of white convicts—39.
Average number of Indian convicts—16.
Number of days, exclusive of Sunday, convicts employed—156
Per cent. of sickness—9.
Work performed:
Cu. yds. of dirt moved and placed—40,000.
Cu. yds. of loose rock moved and placed—4,000.
Number of miles of roadway cleaned and grubbed—3.
Number of culverts constructed—27.

Cu. yds. of concrete placed—250.

Excess cost to county per man per day—.118c.

On account of proximity to penitentiary, cost of transportation negligible. All teams and equipment furnished by the county. Conduct of convicts good. Work satisfactory and convicts satisfied with treatment.

Very truly yours,
McAlester Engineering Company.
By T. W. McLaughlin.

MISCELLANEOUS CONVICT WORK.

In Choctaw County we have no convicts but are making good headway with two gangs of men, one working on the Frisco Highway, west of Hugo, where about six miles of road have been built, including drainage. The second gang has just started south on the Choctaw Highway towards Red River.

The citizens of this county are very progressive and are to be numbered among the good road boosters of the State. The Commercial Club of Hugo furnished, without cost, mules for one gang and are lending aid in every way possible. The commissioners are very active and are getting the value for each dollar expended.

McCurtain County has begun to make strides in road building and has four gangs working, two on the State Highway from Idabel to Broken Bow, one in Wilson Township from Valliant to Red River, and a gang of thirty convicts in Kirk Township from Garvin to Red River.

Despite the fact that road funds are small, the citizens are willing to give time and money to get the work started. The County Commissioners are also interested in the work, and are pushing the movement along in every way possible.

In Wilson and Kirk townships the citizens voted about twenty-five thousand dollars each to build permanent roads, some of which are to be hard-surfaced. At present Wilson Township has a crusher busy crushing limestone rock, and a gang of men grading and putting in drainage west of Valliant.

Kirk Township is working the convict gang from Garvin to Red River, and they have made an excellent showing for the time they have been at work.

These convicts are all negroes, and have been working only about ten days and have graded about a mile of road. The rest of the information that you asked for will be supplied next month, as they have not been working long enough yet to arrive at anything definite.

Yours very truly,
B. E. Clark,
County Engineer, Pittsburgh-Choctaw and McCurtain Counties.

* * *

## North Carolina

In Beaufort County, there has been some seven miles of road about completed, soil and all. In Currituck County, there has been about twenty-five miles of road graded and surfaced where needed.

The road trustees of Fruitville Township, Currituck County, on October 2, let three miles of road to be built across the Great Marsh, from Knott's Island to Morse's Point, and have engaged R. E. Snowden to do the engineering work. This is a borrow proposition, using a dredge to make the borrow for the embankment.

During August and September, Iredell County has done good work on cross roads, and have completed about fifty miles. The Turnersburg road, which was an old macadam road in pretty bad shape, has been completed and is now in fine shape for the winter.

The Roxboro Township road force, in Person County, with A. F. Brown, engineer, have completed the Concord, Helena, Surl, Allensville, and Bushy Fork roads, and most of the Bethel Hill section. They will finish this section in a few days. They are now pushing work on the Woodsdale road, and have about completed twenty-four miles of this.

The Roxboro tobacco warehouse men have employed men to fill up holes and repair the small bridges on the Gordonton road, just outside of Roxboro Township, so as to enable the farmers in that section to get their tobacco to market.

In Lee County, the road force have graveled thirty-six miles on the Capitol Highway in Deep River Township, thus completing the Capitol Highway through the county.

On the Carbonton Road, in Pockett Township, they have graveled 5.65 miles, and this completes the road all the way from Sanford to Carbonton. They have also repaired about six miles of old road in Pockett Township, and about four miles of old road in Deep River Township, and also about three miles of old road in Jonesboro Township. This has all been left in very good condition. The improved highways in the county have been machined several times, and are now in splendid condition. They are now engaged in doing repair work.

The road from Hayne to Autryville, in Sampson County, has been completed, and there is more road work being done in the county than ever before, both in building new roads and in the upkeep of those already built.

In Alamance County, there have been built five miles of top-soil road and about two miles graded. The road from Mebane to Trollingwood has been finished.

Since June 1, Halifax County has done the following road work: Constructed with the county convict force, in Littleton Township, fifteen miles of first-class, standard-gauge, clay-gravel and sand-clay roads—clay-graveled twelve miles, and three miles of sand-clay. The excavation on these roads averaged about two thousand cubic yards per mile. There was something like one acre per mile of clearing and grubbing, the yardage cost for excavation of which was figured at approximately twelve and one-half cents. Since June first they have completed, by contract, three and one-half miles of first-class, clay-gravel road, the yardage price on excavation was twenty-four cents.

Wayne County has completed one more mile of new location eastward toward LaGrange.

The entire section west of Goldsboro has been machined and widened.

Alamance County roads, built five years ago, and having had no proper maintenance since, have been placed in such good condition under systematic maintenance work introduced by W. L. Spoon, that they are attracting attention in the county.

A section of the post road in Iredell County, thirteen miles east of Statesville, has been recovered with top-soil.

Boone Hill Township is to sell forty thousand dollars' worth of bonds at auction, the proceeds of which will go on the Central Highway.

Lenoir County has let approximately fifty-six thousand cubic yards of grading at twenty-three cents per cubic yard to a contractor at Durham. This work will be done over the Neuse River bottoms.

Craven County has completed the road signs and color scheme across the county. Tarvia surface treatment on gravel is being placed east of New Bern, and a convict gang is grading and widening the road east of Pine Grove and Havelock.

MEETING OF HIGHWAY COMMISSION.

The regular quarterly meeting of the State Highway Commission was held in the offices of the commission yesterday. This meeting was of unusual importance, as questions concerning the Federal Aid Fund, under the recent Bankhead-Shackleford Act, were to be decided.

Governor Locke Craig, Chairman Dr. Joseph Hyde Pratt, Secretary Mr. Guy V. Roberts, Mr. E. C. Duncan, Col. Benne han Cameron, Prof. W. C. Riddick, and Prof. T. F. Hickerson were present. After reading the minutes of the last regular meeting, the report of the State Highway Engineer, W. S. Fallis, was read. This report shows the work of the State Highway Commission during the past quarter, with special reference to the work in the western part of the State throughout the section injured by the recent flood that did so much damage to the State.

The engineers of the commission have been busily engaged in engineering work on the reconstruction of damaged roads, and in making surveys for new construction to take the place of the roads damaged during the flood. This report showed that the State Highway Commission has charge of, and is now making plans for, over thirty-five new bridges of two-hundred-foot span or more, and that the engineers of the commission, together with the bridge men connected with the commission, have been actively engaged in salvaging and reconstructing many of the bridges destroyed, saving the counties many dollars in this way.

The State Highway Engineer and the Secretary of the Commission were instructed to comply with the requirements of the Department of Agriculture and furnish all needed data for the purpose of accepting the State's apportionment of the Federal aid money, which will amount to, in round numbers, one hundred and fourteen thousand dollars for the fiscal year ending June, 1917.

Acting in accordance with the provision of Section 8 of the State Highway Law, and fulfilling the requirements of the United States Secretary of Agriculture, a tentative system of State highways was outlined, and a map showing the same was approved for the purpose of indicating to the United States Government the general purpose of the State in expending the money coming to it under the Bankhead-Shackleford Act.

The apportionments for the money for the fiscal year ending June, 1917, were then taken up, and it was determined by unanimous agreement to place the larger portion of this fund for the present fiscal year in those counties most injured by the flood of July 16, as it was realized by the commission that these counties were in more immediate need of assistance in reconstructing and constructing roads than the section of the State whose roads and bridges had not been destroyed during the past summer.

The following apportionments were made of the funds for the first distribution of the Federal aid money:

| | |
|---|---|
| Person County | $10,000.00 |
| Madison County | 9,500.00 |
| Henderson County | 10,000.00 |
| Burke County | 5,000.00 |
| Rutherford County | 8,000.00 |
| Catawba County | 5,000.00 |
| McDowell County | 10,000.00 |
| Wilkes County | 25,000.00 |
| Avery County | 5,000.00 |
| Johnston County | 4,000.00 |
| Carteret County | 1,000.00 |
| Wilmington-Fayetteville Highway | 7,500.00 |
| Mecklenburg-Gaston Counties | 10,000.00 |

There were many other applications for assistance in road work that were very meritorious, and but for the limited amount of funds, would have received an apportionment from the commission. The total applications, however, amounted to over one-half million dollars, and it can be thus seen that it was impossible for the commission to make allotments to all applicants.

The next fiscal year will begin July 1, 1917, and with the Federal appropriation for the State of nearly two hundred and thirty thousand dollars, a great deal more work can be undertaken at that time, and a great many counties who have failed to receive apportionments for this year will then receive allotments.

* * *

## The Cloverland Trail

The Cloverland Trail, unlike many of the advertised highways of America, has seventy per cent. of its mileage completed and ready for the inspection of its friend, the tourist.

Starting at the Wisconsin State line, in the city of Menominee, you run north forty-one miles to Powers. From this point the trail divides, running northeast two hundred fifty-eight miles to the city of Saulte Ste. Marie, and northwest one hundred seventy-four miles to the city of Ironwood.

At the present time there is a continuous stretch of surfaced State reward road from Menominee to Powers, Powers to Nema Junction, and Powers to Ironwood, making a total of two hundred fifty miles.

This trail is a part of the State trunk line road system of Michigan, and its object is to get a continuous highway from east to west across the Upper Peninsula.

Each county has constructed its own portion either by direct taxation or bond issue and each has received a reward for a certain amount per mile from the State, according to type and width of metal surface used.

Much of this road is located through new, undeveloped country and forests. By looking at a map it will be seen that our principal cities are located in the centers of our different mining ranges and on our lake harbors. To connect these centers of population with a trunk line road is a problem that confronts the people of the Upper Peninsula. From a business standpoint it was deemed a necessity, from a social standpoint it brought us closer together, and from a financial standpoint we have already commenced to reap returns by the



increased valuation on the thousands of acres of rich agricultural lands which have been opened up along this route.

At the beginning of this work, five years ago, each County Road Commission employed a competent engineer to act as



chief engineer and superintend all the work done under their jurisdiction. Location surveys were carefully made, and in most cases all construction work was let by contract on a unit price basis. In some cases the clearing, grubbing, and grading



on this trunk line cost as high as seven thousand dollars per mile, and a fair average for this work would be about twenty-five hundred dollars per mile.

The road bed is graded to a width of twenty-four feet on fills and thirty feet in cuts, including ditches. The maximum

grade is six per cent., and wherever possible, the maximum curvature has been ten degrees. All bridges are designed for a live load of not less than fifteen tons, and are constructed of steel or concrete; the maximum width between guard rails being sixteen feet.

The metal surface in nearly all cases is placed sixteen feet in width and consists of nearly all the different kinds of rocks and gravels found in the Upper Peninsula. We have not confined ourselves to any particular kind of material, for the reason that we have few commercial quarries, and we have found railroad transportation to be too expensive and unreliable. By



properly treating our native rocks and gravels found in the immediate vicinity of the roads we are constructing we find that with proper maintenance they will hold up under the present traffic conditions.

A number of counties are now experimenting with road binders and dust layers and within the near future the Cloverland Trail will be a dustless way.

Within two years we expect to have the Cloverland Trail completed. With the other State trunk lines which connect with it, we will present to you a road system of sixteen hundred miles built upon business principles and ready for business.

* * *

## West Virginia

Road-building in West Virginia, regardless of a heated political campaign, is going ahead unmolested, and the fever for better highways which centered in particular localities at the beginning, has spread throughout the State. Bond issues which were held during the summer months, have not proved successful, three having failed during the past two months. The defeat of these bond issues, while unfortunate for the districts in which they were held, formed an object-lesson for other taxing units of the State, as the results have shown beyond a doubt that the best time to vote on a proposition to improve roads is while they are impassible.

The entire State of West Virginia received an agreeable surprise during the past month, when Lewis County came out with the announcement that it would vote on a one-million-dollar bond issue to build hard-surface roads, east, west, north, and south, at the general election on November 7. The proposition, it seems, was worked up quietly and nothing was heard of it in other parts of the State until the county court granted the petition asking for an election. This is the largest sum that any taxing unit of the State has ever voted upon. State Road Engineer, A. D. Williams, upon learning that the petition was to be presented to the court, went to Weston, the county seat, and made such changes in the type and terms of the bonds specified as to save the county just $401,450, or over twenty thousand dollars for each year of the twenty years the bond issue is to run. This plainly shows the alertness of Mr. Williams even though he is compelled to keep his eye on fifty-five counties in this State.

Concrete road-building is flourishing along with the State. On September 21, Harry F. Smith, of Piedmont, West Va., was awarded the contract for the construction of a fifteen-foot concrete road on the Keyser-Piedmont Road, the yardage totaling 16,700 square yards. Conditions for concrete road construction in this section of the State are ideal, there being two mountains of stone specially adapted for this type of construction.

On September 5, the contract for seven miles of fourteen-foot concrete highway in Lewisburg District, Greenbrier County, was awarded to Sands and Cline, of Weyers Cave, Virginia.

On August 12, the Hudson Paving Company, of Charleston, was awarded the contract for the construction of five and one-half miles of fourteen-foot concrete highway in Leadsville District, Randolph County. Part of this roadway will extend through the town of Elkins, and council has voted to construct eight feet of concrete on each side of the fourteen-foot roadway, which will provide a thirty-foot street. The Hudson Company will no doubt be awarded this contract also.

On August 9, the county court of Wetzel County awarded the contract for eight miles of fourteen-foot concrete road in Church District to the Flood and Van Wirt Company, of Hudson Falls, New Jersey.

On October 16, contracts will be awarded in New Creek District in Mineral County for twenty-seven miles of road, but only a small mileage will be hard-surface on account of only a limited amount of money being available. The recommendation of the committee calls for a strip of fourteen-foot concrete through the city of Keyser and water-bound macadam for the country highways.

Engineer Burdette Woodyard, dean of the concrete road builders in West Virginia, who has been building Wood County fifteen concrete roads under a force account system, has resigned, and has been employed by two districts in Roane County to build the concrete roads. Mr. Woodyard was succeeded by Mr. Richard R. Feller, former engineer in charge of road construction in Pleasants County.

Portland District, Preston County, will spend its entire bond issue of two hundred and eighty thousand dollars in building concrete roads, and while the election order calls for thirty-three miles, it is hardly likely that the money available will cover that amount. It is planned to reduce the width on some of the roads to nine feet in order to cover the mileage, but the main roads will be fourteen or fifteen feet wide.

Five field men connected with the State Headquarters of the Portland Cement Association at Parkersburg, began the work on Monday, October 16, of making a comprehensive inspection of all the concrete roads, streets, and alleys in the State. The reports to date in this State are excellent and that such type of paving is affording the cheapest and best type of hard-surface roads that can be secured in West Virginia. The Mountain State is blessed with the material necessary in the construction of concrete paving and this, with the experience in other States with this type of road, is playing an important factor in the decisions of the county courts of the State. Sand and gravel is present in abundance all along the Ohio River, while there are mountains and mountains of hard limestone and other stone scattered throughout the State. Special rates offered by the railroad companies in the transportation of road building material, together with the conditions set out above, makes West Virginia a most profitable field for contractors.

* * *

## County Highway Superintendents Meet in Indianapolis

The county highway superintendents held a very enthusiastic meeting at the Spencer House, Indianapolis, Indiana, on October 11 and 12, nearly every county in the State being represented.

The members went on record endorsing a State Highway Commission. It is their opinion that this commission should act in an advisory capacity, leaving the local control of roads to the different counties.

Dr. I. S. Harold, of Indianapolis, gave a talk before the meeting and outlined a plan for a State Commission; the appointment is hoped to be arranged at the next session of the legislature. He said Indiana should have such a body but that it should not supplant county control. It is his plan that the commission be employed to give unity to the good roads movement in Indiana and direct a general plan.

Professor Geo. E. Martin, of the Engineering Department, Purdue University, also addressed the body, stating that the

office of County Highway Superintendent should be retained, under a Highway Commission, as it is very noticeable that good results are being obtained through the office of Highway Superintendent.

The next meeting will be held at Purdue University, January 16 to 18.

Jas. A. Hendricks, of Adams County, president of the association, presided.

* * *

## Engineers Hold Second Annual Booster

On September 14, 1915, the then newly-formed American Association of Engineers held, at Chicago, its first Annual Booster Dinner. Through this dinner it became known nationally. On October 6, 1916, the association held its Second Annual Booster Dinner at the City Club, Chicago. This last social undertaking surpassed by far any meeting ever held by the association. Although the City Club arranged for twenty-five guests more than anticipated, the attendance was so much larger that a number who had failed to reserve plates could not be served. By the time the program of the evening was reached, there was "standing room only" in the banquet hall.

The meeting was called to order by E. V. Hill, chairman of the Chicago Chapter, who turned the chair over to A. H. Krom, chairman National Membership Committee.

The principal address of the evening was by C. Francis Harding, professor of Electrical Engineering, Purdue University, on "Marketing Engineering Ability." Professor Harding pointed out particularly those essentials which are so vital in the marketing of engineering ability aside from technical training, namely, the ability to write good English. Quoting from his address: "First, it may be said, convince the young engineer of the importance of good written English and the necessity of clear and verbal presentation of his recommendations to a non-technical individual or audience." "It has been well said, 'you can please, you can plead, you can instruct, you can command, or you can rebuke,' in each case with the right use of words, and the right degree of emphasis, if you can use correctly the English language." * * *

"Whereas a mastery of both spoken and written English is more readily recognized as a vital agent which the successful engineer must command, a thorough knowledge should be acquired of business principles with which his audience is too often more conversant than himself. Who shall interpret into the language of dollars and cents the estimates and findings of the engineer? Can any one but him analyze as intelligently the valuations upon which the corporation is to base its rate schedules? Surely no one will question the justification of such a one suggesting to commission or court the fair and equitable gross income which should be allowed a railway corporation in order that it may pay a reasonable dividend upon its stock, when he is perhaps more conversant than any one else with the construction, operating problems, and costs of the particular utility in question. But the average young engineer knows little or nothing about rates, dividends, capitalization, stocks, bonds, etc. But what is worse, many consider it none of their affair. Such are likely to make an adverse criticism of the status of the engineering profession their first matter of business. An estimate of the cost of an engineering project often forms the connecting link between the business world and the engineer. The business manager, the banker, courts, and commissions judge the engineer by the portion of his work with which they are familiar, for example, estimated costs of construction, court testimony, or appraisals of property.

"Accounting practice and the proper treatment of depreciation reserves should be matters of common knowledge to the engineer. Who can say but what many of the financial disasters in the railroad history of the country might have been avoided had the engineers been sufficiently cognizant of the reserves which should have been set aside to provide for the evil day in which the depreciation curve, which has gradually been recording the decay of equipment, suddenly lowers the valuation of the property by leaps and bounds. Should not the young engineers who will soon be estimating the operating expenses of eletrification in Chicago, for instance, know something of the effects that an error in calculation or judgment may have upon the dividends which such a road may pay upon invested capital.

"Business knowledge, however, even when coupled with a command of one's mother tongue, would fall short of the market demands upon the engineer without the necessary tact which must be exercised in all relations with the public.

"The executive quite often fills the gap between the engineering department and the board of directors or the public. He acts as the buffer to receive the rough edges of the average engineering report, and to polish its surfaces that they may make better contact with the layman and the financier. Unfortunately he must frequently stand upon the fence picking the rough burrs from the tree of scientific investigation which he must laboriously open before the tender kernels of opportunity for investment are disclosed. The term "executive ability" has come to mean "marketing ability" in many corporations. It is a comprehensive quality involving many of the factors previously discussed. It has been well defined as "the ability to get others to do what they wish most to accomplish."

"It was said of the late George Westinghouse, 'he is in control of enormous manufacturing companies in both hemispheres. The world is his field. No routine duties in any of his score of companies sap his energy. He thinks, others act. More than that, he inspires, an hundred thousand act. Some of his great spirit filters down through all of the organization, yet each man has his area of responsibility, in which he is perfectly free to follow his own work in his own way. Such a policy develops men, broadens them, fits them for higher duties, and by the same means secures the realization of a great man's ideal. It is other men, including their wills, in the execution of one's plan.' Yet George Westinghouse was an engineer, first, last, and always. There are many such in executive office in this day. The number is rapidly increasing. Whereas we may grant for the sake of argument, the claim of skeptics that executive ability is born and not made, it must be admitted that such a quality is often latent and lies dormant for years in many a human system. It is within the power and very much the duty of this organization to awaken such latent energy among its members and lift those by their own boot straps, as it were, who have the necessary qualities previously outlined, or even better, the ambition and initiative to develop such attributes, out of the ruts of the drafting-room and record cases into the chair of the superintendent and manager. This organization can do much to place the engineering profession upon a high ethical and cultural plain if it will hitch its wagon to a fixed star and hold fast to its moorings with a bulldog tenacity until the world sees its determination and recognizes its merit.

"Let us decide what classes of membership are educational and cultural in scope, and encourage all engineers with ambition to improve their condition to affiliate therewith. However, let the highest grade of membership, by a searching examination of personal qualifications as well as a marked degree of technical proficiency, establish an enviable prestige and sound sociological standard which will mark a new and permanent era in the engineering profession. The physician and the lawyer, each in his own professional society, is bound to his colleague by higher ethical standards than any known to the speaker in any engineering society, unless it be the American Institute of Consulting Engineers. Shall the American Association of Engineers not meet this crying need in the next decade? Shall it not cause mercenary engineers to realize that they owe a duty to their professional brothers and to society of a higher order than that yet recognized? Will this not improve the status of the engineer in the opinion of the other professional men and the public in general? The problem may well be left with the able officers of the association with these suggestions:

"Life is not living
Just for to-day,
Life is not dreaming
All the short day.
To live is to do
What must be done,
To work and be true
For work is soon done.
'T is living for others
To lighten their load,
'T is helping our brothers
And trusting in God."

Professor Harding's address was very ably discussed by J. N. Lewis, Consulting Mining Engineer, of Denver, Colo.

John Ericson, City Engineer of Chicago, discussed particularly that portion of the address relating to "tact," and as Mr. Ericson has held his present position through many changes of political administrations, he may be considered an authority on tact. He complimented the association on its progress and its activities.

Dabney H. Maury, Consulting Engineer, Chicago; L. K.

Sherman, Commissioner on Rivers and Lakes Commission; W. H. Rosecrans, Consulting Engineer; Capt. H. B. Wild, Aeronautic Engineer, also took part in the discussion.

Arthur Kneisel, National Secretary, talked on the proper ethics for engineers and explained how the association was doing much to solve this great problem.

The success of the association is well illustrated by comparison of its membership of one hundred at the first dinner with that of over twelve hundred at this second dinner.

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## *Necessity for Limiting the Loads, Speed and Size of Vehicles

### By Eugene W. Stern, Chief Engineer in Charge of Highways, Borough of Manhattan, City of New York

DURING the past year a great deal of damage has been caused to some of the best pavements in the Borough of Manhattan, City of New York, by heavily-loaded, steel-tired trailers hauled by motor vehicles. The destruction has been so rapid that it has brought to the attention of the authorities the necessity for limiting the loads on vehicles to be hauled over the city streets.

In recent years, there has also developed a greatly-increased use of the motor vehicle, with increase in size, so that many of the streets in business sections of the city are becoming congested. Unless some limitation is placed upon the size of vehicles, this condition will continue to become worse.

As the weight and size of the vehicle increases, the question of limiting the speed also, must be considered, for it becomes evident that what would be a reasonable speed for an ordinary size vehicle of moderate weight, would be detrimental to the public interests in larger and heavier ones.

DAMAGE CAUSED BY VEHICLES TO CITY STREETS.

The most damage seems to be caused by steel-tired vehicles hauled by motor trucks, or trailers, as they are called.

The case in point is here given: A contractor's outfit, hauling rock from the subway excavation on Broadway, is made up of a tractor and trailer. The latter carries six large buckets, weighing about fifteen tons. Its wheels are forty-one inches in diameter, with eight and one-half inch wide steel tires. The load per inch width of the tire is about fourteen hundred pounds.

The springs on the front axle are spiral and on the rear, flat. They are very stiff, and this fact has unquestionably contributed towards the destructive effect of the wheel loads of the trailer. The jarring effect of the loaded vehicle is such that people along the route traveled complain about excessive vibration in their buildings.

The route traversed has been along West 42d Street from 8th to 10th Avenue; north on 10th Avenue to 50th Street; west on 50th Street to the dump dock on the North River.

The age and character of pavements on the rout is as follows:

42d Street from 8th to 9th avenues—Sheet asphalt on concrete foundation, completed July 22, 1912.

42d Street from 9th to 10th avenues—Improved granite on concrete foundation, completed November 14, 1912.

10th Avenue from 42d to 50th streets—Improved granite on concrete foundation, completed February 26, 1913.

50th Street from 10th to 11th avenues—Sheet asphalt on concrete foundation, completed August 27, 1912.

50th Street from 11th to 12th avenues—Improved granite on concrete foundation, completed May 25, 1912.

It will thus be noted that these pavements are all substantially about four years old. They are considered among our best pavements, and have been laid in conformity with the latest specifications. Up to the time when the damage began to be done by the above-mentioned trailers, no appreciable amount of wear had been noticed beyond what ordinarily might be expected on thoroughfares with as much traffic as have the streets above mentioned.

The mischief has all been done in a very short space of time (about nine months), and has amounted to 5,400 yards of repairs on granite (equal to thirty-two per cent. of the total area), costing $6,000, and 1,900 yards of repairs on sheet asphalt (equal to thirty per cent. of the total area), costing $1,900; whereas, prior to this time, the average cost per year of maintenance on the granite was $150, and on the sheet asphalt $70.

The accompanying photographs show the kind of damage that has been done. On granite pavements the granite blocks have been literally crushed and ground into powder. In many cases the blocks were split. The granite used has given splendid service on other streets of the city. The granite on 42d Street, between 9th and 10th avenues, was quarried at North Jay, Me., and has a crushing strength of about twenty thousand pounds per square inch. The granite used on 10th Avenue from 42d to 50th streets, was quarried at Rockport, Mass., and has a crushing strength of twenty-five thousand pounds per square inch. The granite used on 50th Street was quarried at Salisbury, N. C., and has a crushing strength of forty thousand pounds per square inch.

On the sheet asphalt, the destructive effect has been equally startling. In some places it has been ground to small bits; in other places the wearing surface has been completely broken and cracked. It shows many depressions, waves, ruts, and shoves.

In many cases the six-inch concrete base has been shattered; however, in many other cases where the wearing surface has been damaged, the foundation remains intact.

The speed of these vehicles was about six miles per hour in the day time, and at night it was considerably higher—twelve and fourteen miles per hour, and even sixteen at times.

The question of restraining the contractor from hauling such excessive loads was submitted to the Corporation Counsel, and his answer was that as there was no ordinance restricting the loads on vehicles, it would be very difficult to obtain any relief until suitable legislation was obtained.

The effect of rubber-tired traffic has been carefully investigated, and practically no damage has been caused by motor vehicles in which all of the wheels are covered with rubber, beyond what is reasonable, although there are some types of heavily-loaded trucks in use in the city. Our first-class pavements show practically no additional expense for maintenance beyond a reasonable amount.

The manufacturers of motor vehicles have found by experience that about 750 pounds per inch width of tire is about all the load the rubber tire will stand, and this load, together with the resiliency of the rubber and the adequate springs on motor vehicles which good construction demands, seem both together to be the saving features in protecting the pavements against undue wear, even under heavy loads.

The trailer, however, comes in an entirely different class. Not being rigidly connected with the vehicle having the engine and the more or less delicate mechanism, it need not have the rubber tires, nor the easy springs to prevent damage to the tractor, hence builders of these, who form a distinct class from the motor vehicle manufacturers, have allowed their fancy no restrictions in the designs of the tractors, their principal object being to provide a vehicle having the greatest tonnage capacity at the least cost, without considering the destructive effect on the pavement caused by the excessive loads, narrow steel tires, small diameter of wheels, and inadequate springs.

It becomes evident, therefore, that immediate action must be taken to protect not only the pavements of the cities and the municipalities immediately surrounding the cities, but also the country highways which are liable to be exposed to such kinds of traffic, or the tax-payers will be called upon to make very heavy payments to maintain their streets and highways, although these may have been constructed in a thoroughly first class manner and in accordance with the latest ideas.

It goes without saying that a vehicle that would break down the best kinds of city pavements in a short space of a few months, will cause much greater damage to even a first-class country highway much more rapidly.

It would appear to the speaker that regulations properly framed to protect the pavements against the destructive effects of excessive loading in vehicles, should take into account the following factors:

"1. That the wearing or damaging effects of wheel loads on pavements is a function of (a) the load; (b) the diameter of the wheel; (c) the width of tire; (d) whether or not the

*Paper read at Convention of the American Society for Municipal Improvements, Newark, N. J., October 11, 1916.

tire is of a resilient material, such as rubber, or of steel; (e) the kind of springs.

"2. That speed has considerable to do with the damaging effect of heavy loads."

An investigation of the laws and ordinances governing the weights and loads of vehicles, etc., adopted by eight States and forty-nine cities in the United States and Europe, goes to show that only a few laws have been drafted in accordance with modern conditions. It is surprising that even to-day in this country, certain communities require that the width of the tire should depend on the diameter of the axle, regardless of the loading; others make no distinction in the regulations between a wheel large or small in diameter, while still others treat rubber- and steel-tired wheels the same.

Among the most up-to-date ordinances are the following:

*Chicago, Illinois—*

Maximum weight of vehicle, 15 tons.
Maximum load on any one axle, 12 tons.
Maximum load on the wheel, 6 tons.
Maximum load per inch width of tire, 1,000 lbs.
Maximum length, 40 feet.
Maximum width, 8 feet, 6 inches.
Speed: Compatible with safety, but not to exceed nine miles per hour. Not to exceed four miles per hour when truck has defective tire which would cause injury to pavement.
Motor trucks must have rubber tires.
Trailers may have steel tires.

*New York State—*

Maximum weight of vehicle, 14 tons.
Maximum load on any one axle, 9 tons.
Maximum load per inch width, 800 lbs.
Maximum width, 8 feet 4 inches, except traction engines, which may have a width of 9 feet 2 inches.
Speed: Over 4 tons, 15 miles per hour. Over 6 tons, 6 miles per hour, with steel tires; 12 miles per hour with rubber tires.

*State of New Jersey—*

Maximum weight of vehicle, 12½ tons.
Maximum load per inch width of tire, 800 lbs.
Speed: 4 tons, 12 miles per hour (iron tires); 6 tons, 8 miles per hour (iron tires); 10 miles per hour (rubber tires).

*State of Pennsylvania—*

Maximum weight of vehicle, 12 tons.
Maximum load on any one axle, 9 tons.
Maximum load per inch width of tire, 750 lbs.
Maximum width, 7 feet 6 inches; for busses in large cities, 8 feet 4 inches.

*State of Massachusetts—*

Maximum weight of vehicle, 14 tons.
Maximum load per inch width of tire, 800 lbs. (except for hard pavements).
Speed: 4 tons, 15 miles per hour; 6 tons, 6 miles per hour (iron or steel tires); 12 miles per hour (rubber or similar tires).

*Oakland, California—*

Maximum weight of vehicle, 14 tons.
Maximum load per inch width of tire, 800 lbs. (except for hard pavements).
Speed: 4 tons, 6 miles per hour (iron or steel tires); 12 miles per hour (rubber tires).

*England—*

The English have much the most complete and scientific ordinances of any that the speaker has examined.
Maximum weight of vehicle, 12 tons.
Maximum load on any one axle, 8 tons (for trailers, 4 tons).
Maximum weight of vehicle without load, 5 tons.
Combined weight of motor car and trailer, 6½ tons.
Weight on axle to be proportioned to diameter of wheel.
The load per inch width of tire (steel) shall be 840 lbs. for wheels 3 feet in diameter; and an additional allowance of 9⅛ lbs. for every additional increase in diameter beyond 3 feet; and for wheels less than 3 feet in diameter, a deduction of 18⅜ lbs. per inch width of tire for every inch less in diameter than three feet.

Vehicles for military service limited as follows:
Weight of car unladen, 6 tons.
Weight of car with trailer, 8 tons.
Unit of registered axle weight with tires shod with cross bars, 560 lbs.
Maximum width, 90 inches for 3 tons; 90 inches for trailers.
Speed: Dependent on axle weight for iron-tired vehicles. 6 tons, 12 miles per hour for rubber tires. Over 6 tons, 8 miles per hour for rubber tires. Should car unladen weigh more than 3 tons, speed is limited to 8 miles per hour.
If motor draws trailer, maximum speed is 5 miles per hour.

WIDTH OF VEHICLES.

Unless some limitation is placed upon the size of vehicles, the tendency will be to make them larger and larger, until they will become a nuisance and congest the highways. This is now becoming evident in the city of New York, as well as in other cities.

In order to provide reasonable standing room on each side of a street, and, at the same time allow traffic to proceed in both directions, we are forced to limit the width which vehicles take up.

Many of our streets have roadways only 30 feet between curbs. It thus becomes evident that vehicles over 7 feet in width do not allow for two to pass, even using the utmost care. While it is becoming necessary to widen roadways in this borough, it is very difficult to add more than two feet to each side; a 30-foot roadway is thus converted into a 34-foot roadway. In this case, a 7½-foot width for a vehicle would be the limit.

In conclusion, the speaker submits that this subject is one of paramount interest to all cities, and that the time has now arrived when the issues must be squarely faced.

It is hoped, therefore, that a thorough discussion of this matter will ensue, and that the result will be a crystallization of ideas on this most important subject.

APPENDIX.

Memoranda regarding dimensions, weight, etc., of trucks used on the Subway construction work to haul rock from shafts at 39th, 41st, and 43d streets, New York, N. Y.

Trailer, platform over all, 22.2′ x 8.6′.
Wheel Base, 11.5′.
Tread Base, 6.55′.
Length over all, including tractor and trailer, 33′.
Rear wheels of trailer, 41″ diameter, 8½″ wide steel tires.
Rear wheels on tractor, 32″ diameter with double 6″ rubber tires.
Axle of trailer, 2¾″ x 5½″ deep.
Rear springs, flat, 53″ long, having 20 leaves ½″ thick x 3½″ wide.

The trucks carry six skips, which, when loaded with stone, weigh from 2½ to 3 tons each.

There are ten of these trucks in operation. They work sixteen hours per day and each makes about one round trip every hour. The total number of trips, therefore, for the ten vehicles is 160 per day.

MEMORANDA REGARDING GRANITE.

| Location | Quarry | Crushing Strength Per Sq. In. |
|---|---|---|
| 42d Street, 9th to 10th Ave. | North Jay, Me. | 20,000 lbs. |
| PERCENTAGE OF REPAIRS. | | |
| 1915 .4 | | |
| 9 months of 1916 45. | | |
| 10th Ave., 42d to 50th St. | Rockport, Mass. | 25,000 lbs. |
| PERCENTAGE OF REPAIRS. | | |
| 1915 .5 | | |
| 9 months of 1916 26. | | |
| 50th St., 11th to 12th Ave. | Salisbury, N. C. | 40,000 lbs |
| PERCENTAGE OF REPAIRS. | | |
| 1915 .6 | | |
| 9 months of 1916 36. | | |

# Better Roads and Streets

Published Monthly at Dayton, Ohio
BY THE UNITED BRETHREN PUBLISHING HOUSE
for the
BETTER ROADS PUBLISHING COMPANY
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Subscription Agents Wanted Everywhere. Good Commissions


A farmer ten miles out from town on a good road is nearer town than a farmer five miles out on a bad road.

* * *

The type of road to be selected for any particular location depends upon the kind and volume of travel, soil conditions, and very often other factors.

* * *

The country road must be adapted to both horse-drawn and motor vehicles, and it is subjected to very heavy loads, as well as rapidly-moving motor cars.

* * *

The road surface or pavement is the particular part of the road most likely to come to the notice of the traveler. It is that part of the road that is directly subjected to all traffic and to the disintegrating action of the elements.

* * *

Good roads are so fundamental to the material progress and prosperity of communities that prejudice for or against any certain type cannot stand in the way of that line of improvements much longer.

* * *

One question in which motor truck manufacturers are now interested is, what is the length of the road to be built, and is the road to be built of sufficient kind to carry the kind of a truck for the purpose its use is intended?

* * *

The third annual meeting of the Northwestern Road Congress will be held at the Sherman Hotel, Chicago, Illinois, December 7 and 8, 1916. An interesting program has been prepared and many speakers of national prominence in highway work will discuss the most important questions of the day.

* * *

The dedication of the new concrete link in the New York Extension of the William Penn Highway will take place at Easton, Pennsylvania, on November 2. Appropriate ceremonies will be held.

* * *

Whenever a road is subject to a varied and heavy traffic, and the conditions are right for substantial improvement, the selection of type for such an improvement should be of a kind that will resist usage longest and remain in good condition with the least cost of maintenance and upkeep.

* * *

Mr. Clark R. Mandigo, for two years on concrete construction for railroads, three years Superintendent of Construction, War Department, United States Government, and six years Assistant City Engineer of Kansas City, Missouri, has become a member of the engineering staff of the Kansas City office of the Portland Cement Association. Mr. Mandigo is a graduate of Harvard University, and his past experience should make him a valuable addition to the Cement Association.

By a glance at the picture used on the front cover page of this issue it is almost impossible to tell what type of construction is intended, but the truth of the matter is, the picture was taken on the Demonstration Monolithic Road at Paris, Illinois, immediately following the setting of the forms and commencing the operation of the cement mixer for the sand-cement base.

* * *

The permissable weather conditions for the 1916 construction period is about at an end, and road and street officials must answer to the traveling public and to the tax-payers, and make a showing of their stewardship for the year, for within a very few weeks the condition of the highways will tell the story for themselves.

* * *

Russia will have a tremendous awakening in business and educational affairs, when the great war is over, in the opinion of J. E. Suerwald, of New York, special representatives of the Garford Motor Truck Company, of Lima, Ohio, who has just returned from a year's trip abroad. During his absence from the United States, Stuerwald was in Russia, Sweden, Norway, Denmark, and England, and he found time, despite business affairs, to look into the economic situation in the countries he visited.

"The millions of Russian soldiers and the millions of Russian non-combatants have, for the first time in their lives, observed how the Germans, English, and French live, and when the war is over and they return to their homes, they will have a desire for better living conditions, for education, and for other advantages possessed by the people of neighboring countries," said Stuerwald. "I was told that only five per cent. of Russian people can read and write. Such a condition will not exist much longer. Even the most ignorant are now aware of the handicap under which they have labored so long, and at every point I visited on the various battle fronts, I saw evidence of the desire on the part of the big, strong fellows to improve the conditions under which they have been living."

Speaking of motor truck service in the war zone, Stuerwald was enthusiastic in praising the American product. He declared that in nearly every instance the American cars have outlived the foreign cars in spite of the fact that their cost, including freight, is about the same as those of European manufacture.

"A big percentage of the first shipment of Garford trucks in 1914 are still in active service," he said. "There are thirty of them armored and equipped with rapid-fire machine guns at Odessa, Moscow, Petrograd, and Riga. The second shipment of two hundred and forty Garfords went to the department in charge of the Red Cross and ambulance service at the various fronts. Another shipment of two hundred and ten Garfords, equipped with transport bodies, is at the Rivle front, right in the line of battle, transporting men and ammunition.

* * *

On August 7, several hundred good roads enthusiasts showed their appreciation of good roads by gathering at Eagle's Nest, located fourteen miles west of Zanesville, on the Old National Pike, to witness the dedication of a memorial to former governor of Ohio, James M. Cox. The principal speaker was Judge J. M. Lowe, President of the National Old Trails Road Association, of Kansas City, Missouri.

* * *

## Highway Officials Annual Meeting.

The annual meeting of the American Association of State Highway Officials will be held at St. Louis, Missouri, on December 5, 6, and 7. The American Association of State Highway Officials is undoubtedly one of the most important organizations connected with the public highways in the country today, and with its membership lies the success of the new Federal Aid Law, for the action of the several States will result largely from their recommendations. Many subjects of vital importance to our public highways will be discussed by them in their annual meeting in December. Mr. Henry G. Shirley, Chief Engineer of the State of Maryland, is president of the association, and Dr. Joseph Hyde Pratt, Secretary of the State Highway Commission of North Carolina, Chapel Hill, North Carolina, is secretary.

* * *

Wherever concrete can be cured by ponding, that method is to be preferred over all others. California was, we believe,




*Scott Street, Milwaukee, Wis. This is what happened when the road was weaker than the automobile*

*When resurfaced with Tarvia, this road became stronger than the automobile*

# *Tarvia Makes Roads Stronger than the Automobile*

Plain macadam roads were all right in their day, because they were stronger than the slow-moving horse-drawn vehicles.

The automobile, however, is heavier and faster, and in these days plain macadam roads crumble away swiftly.

The remedy is once more to make the road stronger than the automobile by *bonding the macadam with Tarvia.*

Tarvia is a coal-tar preparation which is introduced into the macadam either at the time of construction or afterwards. Its function is that of a powerful, plastic binder.

To the dry, hard and brittle macadam, Tarvia contributes a necessary element of plasticity and cohesiveness. Automobiles, instead of grinding away the surface, roll it down smoother when Tarvia is used.

Dust on a road is a sign that the surface is disintegrating; that expensive road material is being ground up and blown away by the winds.

There is practically no dust on a tarviated road, for traffic does not tear up the plastic, malleable surface.

Progressive communities are rapidly giving up the use of plain macadam. It costs too much, because it won't stand modern traffic. It requires incessant renewal and repairs.

Tarvia in any town marks the beginning of a new era of dustless, mudless, durable, economical roads.

The use of Tarvia will not add to the road taxes; on the contrary, it tends to reduce them, because the roads will last longer and there will be less maintenance to pay for.

*Illustrated booklet on request.*

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This Company has a corps of trained engineers and chemists who have given years of study to modern road problems.

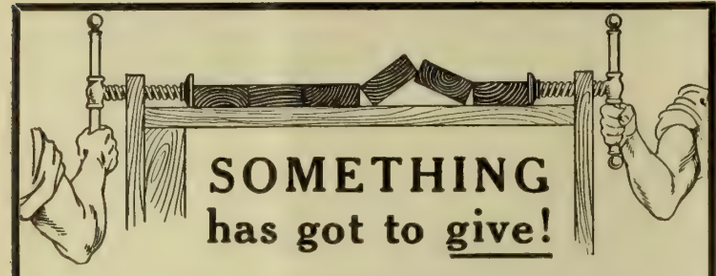
The advice of these men may be had for the asking by any one interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention

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the first State to practice the flooding of the finished concrete pavement with a view to keeping moisture present, to enable the concrete to acquire strength and hardness under proper conditions.

Even where water is obtainable for use in this manner, it is, of course, desirable to prevent unnecessary loss. This is particularly true in hot climates where evaporation is rapid and where scarcity of water more often prevails.

The original method of diking roads in California has been improved upon by adding an additional longitudinal dike near the edge of the concrete, as shown in an accompanying view. This prevents unnecessary loss of water and gives double assurance that concrete will be covered at the crown of the pavement as well as at the sides. These two precautions are very essential, and the added dike seems to make the desired ends more certain.

* * *

The annual meeting of the American Road Builders' Association will be held November 3, at the Automobile Club of America, 247 West 54th Street, New York, N. Y. The sessions will commence at 2:00 p.m. Aside from a meeting of the Board of Directors and reports of officers and committees, the principal interest of the meeting will center in the election of officers for the year 1916-1917. This is now being conducted by means of a mail ballot, but the polls will not close until 4:00 p.m. on the day of the meeting.

In the evening, the annual "get-together" dinner will be held in the grill room of the Automobile Club of America. This will be attended by the members of the association and their friends, and the organization extends a cordial invitation to all who are interested in the work of the American Road Builders' Association, or in the good roads movement in general, to be present. A program is being prepared, and nothing will be left undone to make the occasion most enjoyable and instructive. The result of the election will be announced during the dinner. All who desire to attend are asked to notify the secretary of the association, 150 Nassau Street, New York, N. Y., as far in advance as possible.

* * *

The Training School for Public Service, Bureau of Municipal Research, 261 Broadway, New York City, N. Y., is preparing to conduct night classes in Municipal Highway Enginneering, in charge of Professor Arthur H. Blanchard, of Columbia University, and Engineering Administration in charge of Mr. E. P. Goodrich, Acting Director of Municipal Research; Mr. J. T. Fetherston, Commissioner, Department of Street Cleaning, New York City, and Mr. George B. Ford, Consultant to Committee on City Plan, New York City.

Classes for the first half of the year, consisting of instruction in Municipal Highway Engineering, begin November 14, is made up of fifteen conferences, and will be held on Tuesday evenings, 8:00 to 10:00. The second half of the year, devoted to Engineering Administration, will be held on Tuesday evenings, 4:00 to 6:00.

The purpose of the school, through field work and courses of instruction given at the school, and in connection with other institutions of learning in New York City, is to prepare students for official and unofficial public service.

It gives particular attention to training city managers, administrative officers for all important branches of city government, staff members for bureaus of municipal research, secretaries for chambers of commerce, civic secretaries, reference librarians, legislative drafting experts, consular and Federal trade service officers.

* * *

In an address before the conference of State Highway officials at Washington on August 16 the Secretary of Agriculture speaking on the Federal Aid Road Law said: "The law involves another thing, the pledge of the faith of the State to meet in full the Federal appropriation for the entire period covered by the act. The State Legislature may not be able to appropriate money one year for the whole period covered by the act, but it can pledge the faith of the State to meet the financial provisions of the act for the period covered by it. This is as it should be. It would be unfortunate if it were otherwise. It would be wasteful not to make plans at the outset for the full period covered by the act; it would mean piecemeal road building and much dissipation of effort and misdirec-

# THE OHIO GOOD ROADS FEDERATION

## Ohio division of the National Highways Association

## PURPOSES!

"The Ohio Good Roads Federation is an agency created for the purpose of focusing the thoughts of the people upon the best plan for improving the public roads of Ohio."

"To disseminate knowledge and increase the interest relative to the ethical and economic value of our public roads."

"To aid all efforts for their improvement."

"To advocate wise, equitable and practical road legislation."

## SERVICE!

**To the Legislator - - - To the Road Official - - - To the Citizen**

TO THE LEGISLATOR---Our Legislative Committee is familiar with the road laws of other States in the Union and with those of Ohio for the past eight years. We are collating suggestions from many sources which will be submitted to the General Assembly at its next session. Get in touch with us, so that you may be "PREPARED" to discuss all phases of this great question intelligently.

TO THE ROAD OFFICIAL---The federation thru its bulletins, booklets and general service can be of wonderful help to you in your local work. Be friendly and let us help you solve some of your perplexing problems. We've been thru the mill in taxation, legislative procedure and administrative methods. We are ready to help you—it's up to you.

TO THE CITIZEN---A community is what its people make it. The more wide-awake and enterprising citizens there are in it the greater the community life and civic pride. Interest in the improvement of roads is the duty of every citizen. A community is known by the roads it keeps, the condition of its roads is its greatest advertisement—accordingly too many communities are poorly advertised. Well-kept highways represent the thrift and industry of the people and the efficiency of the local road officials; whereas, mud, ruts, bumps, weeds and brush represent the indifference of the officials and indicates an inactive, don't-care public sentiment.

**What is your community doing? Can we help you?**

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—Says City of Cleveland

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**Has These Six Points of Superiority**

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**Commissioner Schulz Proves This--He Says:**

"The Plymouth Locomotive cost us one-third less to install, 52 cents a day for gasoline and three and three-fourths cents a day for lubricant, while coal for the compressed-air motor cost us $1.50 a day—a difference of 68 cents a day in favor of The Plymouth. We consider The Plymouth is cheaper to operate than an air motor, horses or any other power-driven system."

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tion of funds. These requirements hold whether the State as such, under the existing law, may engage in road building or not. The provision that where the State may not engage in highway improvement the money may be secured if counties raise an amount sufficient to meet the apportionment of the State involves the necessity on the part of such counties of raising an amount to meet the full apportionment for the State, the existence of a highway commission, and compliance with all the other terms of the act. I speak of this because there are evidences that individual counties think that, if they raise a certain sum of money, they will of necessity get a corresponding sum from the Federal treasury. That is not my construction of the act and not the one that will be likely to prevail."

* * *

The Fourteenth Annual Convention of the American Road Builders' Association will be held in Mechanics' Building, Boston, Massachusetts, during the week beginning February 5, 1917. The program, which is in course of preparation, will include papers and discussions on subjects connected with road and bridge building and street paving by the foremost authorities of the United States and Canada.

In connection with the convention, and in the same building, will be held the Eighth National Good Roads Show. This exposition will include exhibits by leading manufacturers in the United States of the machinery and materials used in road and paving construction and maintenance.

This exhibition, which has been a feature of the American Road Builders' Association conventions for a number of years, has increased in size and interest year after year. The coming exhibition takes on added importance on account of the enormous sum of money appropriated under the recently-enacted Federal Aid Law, and the additional large sums to be expended for road building by the various States and smaller units of government.

Mechanics' Building, in which the convention and Good Roads Show will be held, is admirably situated and fully equipped for the purpose. It is located on Huntington Avenue, within convenient distance of the leading hotels and business district of Boston. The building is well lighted and heated, and is thoroughly modern in its appointments. It contains ample space for practically any number of exhibits, and is adaptable to exhibits of any size, as the floor plans just published indicate.

The management announces that the services of Mr. H. G. McConnaughy have been secured as Director of Exhibits. Mr. McConnaughy has had many years' experience in this line of work, and is well known in connection with the management of the exhibitions held under the auspices of the American Electric Railway Manufacturers' Association.

* * *

## The Engineer and the Public

### A Discussion of the Work of Bureaus of Municipal Research and State Leagues of Municipalities

An abstract of a paper presented at the Annual Meeting of the American Society of Municipal Improvements, Newark, N. J., October 10-13, 1916, by Edward T. Paxton, Secretary of Bureau of Municipal Research and Reference, University of Texas, Austin, Texas.

BEGINNING in New York, "municipal research" has penetrated the far corners of the United States, and sent its influences even farther. Research bureaus have been established in practically every State; by private endowment; by universities and colleges, or by cities themselves.

Municipal research is the systematic securing of knowledge about municipal affairs on the principle that the more we know about cities, the better we shall be able to run them.

The municipal-research movement comes close home to the municipal engineer, because the first piece of research undertaken by an organized agency was an engineering investigation, and, aside from purely financial and administrative problems, the field of work of the city engineer affords, perhaps, the most profitable area of municipal research.

Municipal research is merely an extended application of engineering methods.

With the State-wide municipal research bureau has come the State league of municipalities, with its wide opportunities for municipal co-operation.

The extension of scientific inquiry and scientific methods farther and farther among the cities and into State and Na-




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# *The Employment of Vitrified Clay Sewer Pipe for all Culverts and Drains*

will do just that, because by literal centuries of test, under most exacting conditions, this material has proved absolutely indestructible, efficient and thoroughly dependable, while its cost, both "first" and "last" is lower than any other.

In this magazine we are going to tell you, from month to month, about the wonderful service rendered by Vitrified Clay Sewer Pipe. Meanwhile, every public official interested in highway or street construction, working to benefit the tax payer, is urged to write for literature we shall gladly send.

**The Sewer Pipe Mfrs. Association**

*John L. Rice, Field Commissioner*

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tional governments, opens to the engineer, and especially the young engineer, the possibilities of a new profession.

Just at present the public seems to exhibit more confidence in the engineer than the engineer exhibits in the public. The engineer must broaden his outlook and prepare to take his proper place of leadership in public life. This means, first, broadening the scope of engineering education; second, increasing the sympathy and co-operation between city engineer and bureau of municipal research.

* * *

The Tenth Chicago Cement Show will be held in the Coliseum, Wednesday, February 7, to Thursday, February 15, 1917, inclusive.

The concentration of exhibits in the Coliseum, Balcony, and Annex will enable visitors to inspect them conveniently. Machines and products will be closer together, thus facilitating comparison and enabling buyers to make purchases more expeditiously. However, as less space will be available for the next show than for the last show, each exhibitor will be asked to apply for as little space as can accommodate his exhibit, and in this way it is hoped to make the number of disappointed applicants as small as possible.

Closing the show on Thursday will make it unnecessary for exhibitors to be away from home more than one Sunday.

There will probably be a joint exhibit of cement companies similar to the one at the last show. The Ninth Show Joint Exhibit was considered by visitors, the building fraternity, and the trade press to be the most complete and comprehensive display of the uses of concrete ever presented to the public. The exhibit was broadly educational and promotional in its scope. It interested the general public as never before in the uses and possibilities for concrete. It is planned to make the Tenth Show Joint Exhibit even more comprehensive than that of last year, and to show to as large an extent as possible, products in the making.

During the eight-day period, Chicago will be the center of activity in the building material industry. The National Builders' Supply Association will hold its annual convention at the hotel Sherman, February 11 and 12, and the Illinois Lumber and Builders' Supply Dealers' Association at the same hotel, February 13 and 14. While the dates have not been definitely set, it is probable that the American Pipe and Tile Association will be in session during the Cement Show. It is also likely that the American Concrete Institute will meet at the same time. Beside these organizations, it is possible that the American Association of Engineers and other similar associations will convene in Chicago during the show.

Since only the Coliseum and Annex will be used for the next show, it is probable that the demand will exceed the available space. Therefore, those desiring to exhibit should make application for space at once.

* * *

## Concrete Roads for New Zealand

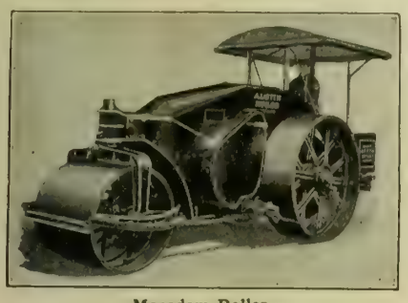
The New Zealand authorities, both local and national, are carefully studying the subject of good roads, realizing that this is the best way to open up the hinterland of the dominion. The roads of the country, in the main, are not in very good condition. There are some good stone roads about the larger centers, but few of them extend out more than twenty-five or thirty miles. Their upkeep has been found very expensive, especially in the northern part of the country, since the rainfall is heavy and washouts are numerous because the stone used is soft and grinds up and decays rapidly.

Of late, much has been said in regard to the construction of concrete highways, and it is thought that this will be far cheaper in the long run than the stone roads as they are now constructed, for the reason that the upkeep will be so very greatly reduced. It is estimated that a mile of twelve-foot concrete road, four inches thick, could be built for two thousand dollars more than a mile of ordinary stone road, on which there would be a saving in upkeep for the first five years of at least twelve hundred dollars, while at the end of ten years there would be a saving of seven or eight thousand dollars per mile.

INFORMATION AS TO AMERICAN METHODS AND MACHINERY DESIRED.

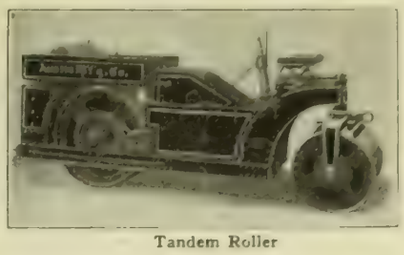
The experiments being carried on in the United States along this line have received much attention here and are being

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Macadam Roller

FULFILL the requirements of up-to-date road builders and contractors. A roller that saves 30 to 50 per cent. of operating costs, causes no smoke, noise and annoyance, and is always ready for work on a moment's notice is the machine that really gives the service you have a right to expect.



Tandem Roller

## *Austin Rollers Use Kerosene*

so that the temporary high price of gasoline is no argument against them. Even at present gasoline prices, our roller shows vastly greater economy than can be got from any steam roller.



Road Oiler with Heater

## The Austin Pressure Oil Distributer

Has been adapted by leading road authorities owing to its superior method of distribution and its convenience in operation. The driver controls all operations from his seat. A second man is not required.

The machine will handle any of the lighter grades of asphalt or tar without heating. When fitted with our improved heating attachment, will handle heavy grades most satisfactorily.

Full details and expert information as to the best methods of accomplishing this work will be gladly furnished by us on application.

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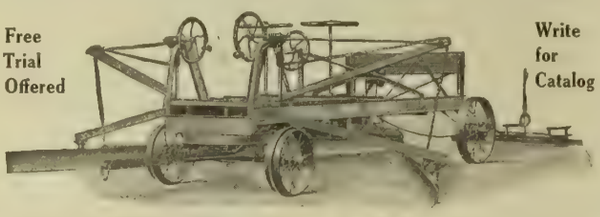
We manufacture a full line of road making, earth handling and rock crushing machinery
Send for our New Road Builder's Guide describing our entire line.

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Consultations on specifications, materials and methods. Specialty of recommending efficient and economical equipment and plant Accurate estimates for contractors.

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**A. H. Blanchard**
M. Am. Soc. C. E. M. Can. Soc. C. E.
**Consulting Highway Engineer**
Broadway and 117th Street New York City

More and more we are all approaching the question, "Shall we build the road for the vehicle, or shall we build the vehicle for the road?" More and more tax-payers and users of public highways are acquainting themselves with traffic conditions of public highways and as soon as they become more informed as to the real demand for highways proposed to be constructed, they intend to force the engineer to make a positive statement as to the best type to be constructed to fill the requirements the highway will have to meet.

carefully studied, with the result that it is proposed to adopt some of these methods. This will call for the use of up-to-date American road-making machinery, and I would request that the Aukland consulate general be supplied with catalogues, price lists, etc., of this class of machinery, together with such printed matter as may be available for distribution covering the construction, cost, and maintenance of concrete roads. This information can be put in the hands of persons who are in position to make good use of it. There is one feature in the construction of concrete roads that does not need to be taken into consideration in New Zealand, and that is frost, since there is no frost to speak of in the North Island, and but little in the South Island.

A very good grade of cement is manufactured in large quantities in New Zealand, two large cement works having been installed within the last two or three years, supplied principally with up-to-date American machinery, and it is possible to manufacture the cement here at a price much below the cost of imported cement. This domestic cement seems to be good enough for concrete road building and ordinary structural work.—U. S. Commerce Reports.

* * *

## Special Cars for Ecuador

A consignment of special dump cars for the handling of heavy corrosive material has been made by Orenstein-Arthur Koppel Company, of Koppel, Pa., to Marengo and Parodi, at Quito, Ecuador.

To resist corrosive action, the bodies of these cars are built of oak, heavily reinforced by galvanized bars. In other respects the cars are of the Koppel standard cradle type, with round buffer frames, spring bumpers, continuous draw bars, and roller bearings.

The cars are constructed to dump clear of the rails and underframe, thus facilitating the work and avoiding any delay.

* * *

## Patents Issued on Colloidal Bitumens

United States patents have just been issued to Clifford Richardson on an improved "bituminous substance" and on the process by which this product is manufactured. Similar patents have also been granted in Canada, Great Britain, France, and Italy. It is believed that these are the first patents covering a product and process involving the introduction of colloidal matter into bitumens of all types. According to the inventor, he obtains an increased degree of body, or stability, in these bituminous substances, by means of the addition to and intimate and uniform dispersion through the bituminous substance of a proper proportion of a substance in the state of a disperse colloid. The process consists in the introduction of clay in the form of a colloidal aqueous paste and combining this paste with the bitumen in such a way that when the water is subsequently driven off, the bitumen forms the continuous phase of the colloidal material.

The products resulting from this method of incorporating clay in colloidal form with bitumen, has markedly different properties from products into which the mineral matter is introduced in the form of a dry powder. The products made by the Richardson method range all the way from materials resembling vulcanized rubber to plastic, but at the same time very stable mixtures suitable for paving and many other uses.

* * *

## Unique Use of Motor Trucks

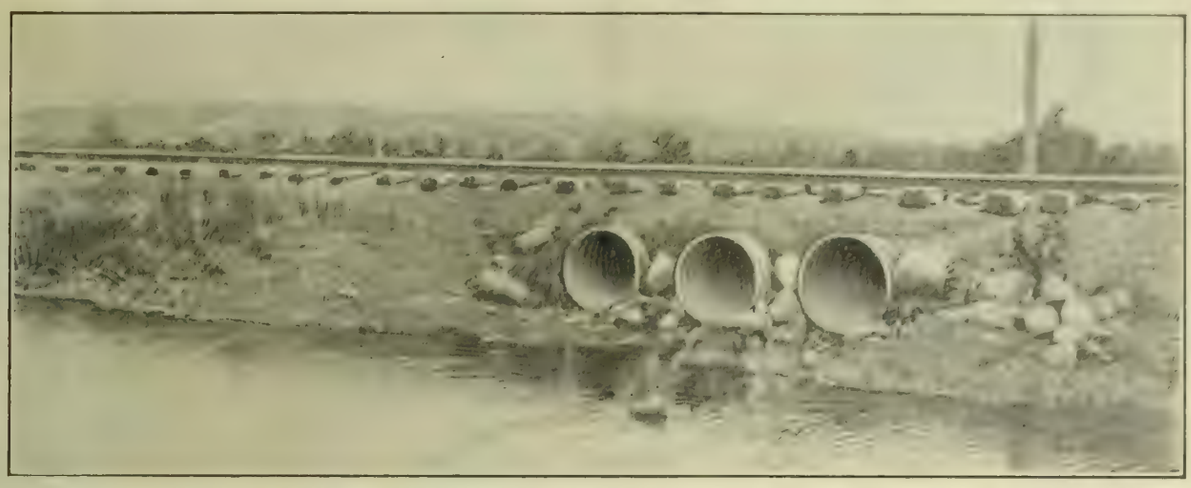
The wide and varied use to which the motor truck is adapted is shown in the performance of two motor trucks

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Made from KEYSTONE COPPER STEEL—Unequaled
**FOR ROADWAY CULVERTS**
as well as for Roofing, Siding, Flumes, Tanks, and all forms of exposed sheet metal work. Demand APOLLO-KEYSTONE for your Roadway Culverts. Look for the stencil—it insures greatest durability and resistance to rust. Accept no substitute. Write for our free booklet showing actual service tests.

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## For Adaptability, Efficiency and Long Service

They are adapted to steam and electric railroads, to rural earth roads and to city boulevards. Their corrugated form and overlapping joints confer ample strength together with a resiliency or **toughness** which enables them to stand more grief and hard luck than anything else in the form of a culvert. And their material is the **purest,** most **even** and most **durable** of irons.

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AMERICAN ARMCO INGOT IRON
"ARMCO" IRON
the product of The American Rolling Mill Co. is the standard for Purity and Rust-Resistance

**ARMCO IRON CULVERT MFRS. ASSN.** **Cincinnati, Ohio**




## No "Ifs" or "Almosts" About It

When we say **"BUCKEYE BEREA"** is always good!

**It is Selected Natural Sandstone—the Aristocrat of Curbings—Nature't own enduring product.**

Whatever the weather it does not crack, crumble, chip nor disintegrate—no hidden flaws, but uniformly qualified throughout.

When you are laying a permanent pavement, why not put in a *permanent curbing, too?* That's only common sense! Those who have used *"Buckeye Berea"* say that it outlasts the pavement itself. That can *truthfully* be said of few other types of curbing.

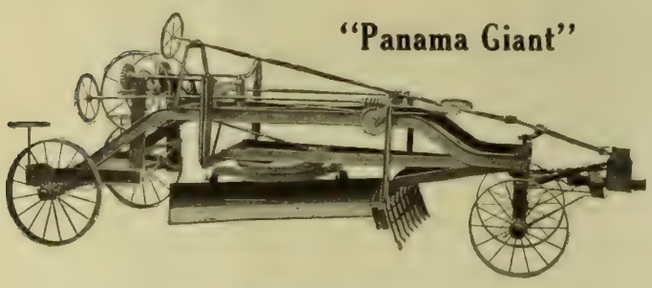
OHIO QUARRIES COMPANY, Cleveland, Ohio.

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# Build Better Roads Buy Better Tools

"Panama Giant"

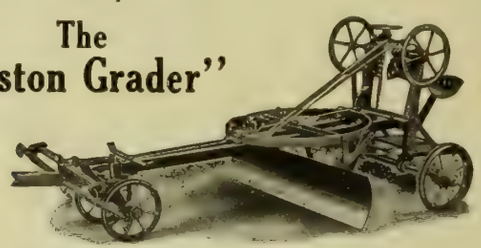


## Use the "Panama Line"

YOU cannot do good work with poor tools, nor can you build good roads with poor road machinery. The successful contractor assures an almost perfect job by employing able workmen and the best of machinery—in most cases you'll find he uses "the Panama Line," the line where quality comes first.

In the "Panama Line" there is 'a machine for every job,' and each machine does its particular job more thoroughly than any other machine of its kind. You'll be interested in our catalogue, which we will gladly send you on request.

The "Boston Grader"



## Built 'Up to Panama Standard"

The "Boston Grader" is the most practical low priced grader ever made, it meets the requirements of a drag, a two horse grader and a four horse grader and like every other "Panama" machine, is built "Up to Panama Standard." Owing to its special construction and roller bearings this machine will handle a wider range of work at less power than any other similar machine.

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Gentlemen:-

Send your catalog as offered in Better Roads and Streets.

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owned and operated by Hanlon and Okes, prominent contractors of the Middle West, with offices in Minneapolis, Minn., and Sioux City, Iowa. Two trucks owned by this firm, one a four- wheel-drive truck and one a Jeffrey Quad, are used in place of a locomotive to draw a string of heavily-loaded Koppel cars on a narrow-gauge track. These trucks draw from eight to twelve of these cars loaded with one and one-half yards of gravel or crushed rock each trip.

The four-wheel-drive truck shown here and owned by Hanlon and Okes, is hauling the crushed rock, gravel, and cement being used in the construction of a sixteen-foot concrete highway going north from Sioux City on what is known as the Perry Creek Road. The large amount of material



**Three-Ton Four Wheel Drive Truck towing twelve 1½ yard Koppel cars of sand and stone for concrete paving**

hauled is indicated by the fact that from five hundred to six hundred linear feet of pavement are being laid daily. The track is four miles in length, and ten round trips are made each day.

The other truck, a Jeffrey Quad, was used in the same manner in the construction of four and three-fourths miles of concrete paving on the Broken Kettle Road, a tortuous, ex-



**Two-Ton Jeffery Quad Truck towing eight 1¼ yard Koppel cars of sand and stone on paving work outside of Sioux City, Iowa**

ceedingly-hilly highway leading into Sioux City. The work there is about completed and this truck and trailer cars have been sent to operate on another long stretch of paving to be done in the vicinity of Winona, Minnesota.

* * *

## Bulletin of the Motor Truck Club of America, New York City

A commission has been appointed by law for the State of New York, consisting of the Commissioner of Highways, State Engineer and Surveyor, and the Superintendent of Public Works, to recommend new schedules of registration fees on



*Concrete Road around lake near Cadillac, Mich.*

# Concrete Ends the Folly of Long Term Bonds for Short-Lived Roads

During 1915 the average cost of maintaining 5,611 miles of roads in the State of New York was $750 per mile. This cost, given in the 1915 Report of the State Highway Department, includes overhead expense as well as cost of labor and materials. Of all types maintained, waterbound macadam was highest at $1,055 per mile and concrete lowest at $129 per mile. The cost of maintaining concrete was lower by $621 per mile per year than the average spent on all types of construction. Referring to *concrete* the report states that *"the expenditures were nearly all for labor and materials on the shoulders and gutters, a small expenditure only being required on the pavement."*



*Concrete Road between Batavia and Geneva, Kane Co., Ill.*



*St. Mary's-Elenborough Concrete Road, West Virginia*

In Milwaukee County, Wisconsin, concrete roads have been in use since 1912. The cost of maintaining the road surfacing is kept separate from the cost of shoulders and ditches. In 1915 Milwaukee County spent $35 per mile in maintaining concrete.

The life of a road surface varies according to the materials used and the type of construction. The State of New Jersey has taken this fact into consideration by recently passing a law limiting the life of road bonds as follows: sand and gravel, 5 years; water-bound macadam, or penetration process, 10 years; bituminous concrete, 15 years; block of any material, or sheet asphalt *on concrete*, 20 years; *concrete construction* not less than 6 inches thick, *20 years*.

*Concrete* solves most problems of road finance and construction as hundreds of splendid records and expressions of satisfaction will show. Edward N. Hines, Chairman of the Board of County Road Commissioners, Wayne County, Michigan, in a letter written September 17, 1915, states that "at a cost of $30 per mile per year, Wayne County has maintained its 128 miles of concrete roads in the highest state of efficiency thereby prolonging their life and adding to the comfort of the user and saving money to the taxpayer."

Concrete paving when properly built has an unknown limit of life. The oldest concrete pavement known—laid 23 years ago in Bellefontaine, Ohio—is still giving good service.

**CONCRETE FOR PERMANENCE**

*You are anxious to reduce road taxes in your community and encourage at the same time sound financial methods in road building.*

*Write for a free copy of "Specifications for Concrete Roads, Streets and Alleys."*

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111 West Washington Street, Chicago

ATLANTA, Hurt Building
DALLAS, Southwestern Life Building
INDIANAPOLIS, Merchants Bank Building
KANSAS CITY, Commerce Building
NEW YORK, 101 Park Avenue
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PITTSBURG, Farmers' Bank Building
SAN FRANCISCO, 116 New Montgomery St.

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An Improved Asphaltic Concrete Pavement made by special process.

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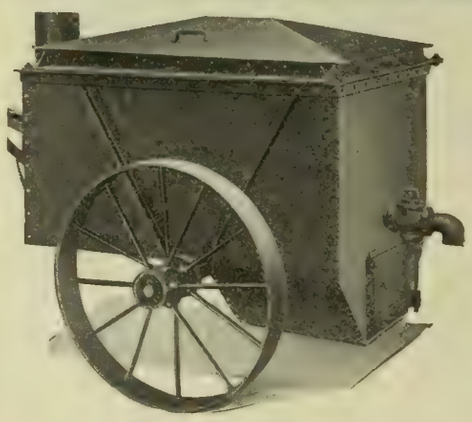
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**The Bitoslag Paving Company**

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**(Proof of the Heater is in the Heating)**

This heater has been designed especially for the purpose of heating small quantities of tar and asphalt in connection with repair and maintenance work on streets and roads. Its compact design and durable construction without doubt make it the most efficient on the market.

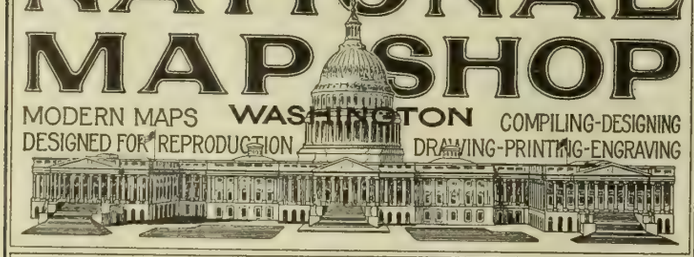
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automobile trucks, such fees "to be based on the time and extent of use and wear and tear of public highways by such vehicles." This commission has held no meetings and we are thus unable to form any opinion as to how greatly the license fees will be increased.

A special committee appointed by the Commissioner of Motor Vehicles of New Jersey has met, however, and has reported on the subject. As many of the members of the Motor Truck Club operate trucks in New Jersey, and as any action taken in the State of New Jersey will, no doubt, have considerable influence on the action of the New York Commission, we give herewith a digest of the report of the New Jersey Committee, as follows:

RECOMMENDATIONS.

1. A great increase in license fees. (We understand the present highest rate is $25 per year. The proposed highest rate is $125 per year.)
2. The driver of every truck shall carry way bills for each load, showing gross and net weight carried.
3. The speed of motor trucks is limited according to size of tire, diameter of wheel, and weight of vehicle and load. Apparently the average one-ton truck loaded, shall not exceed in speed 14 miles per hour—three-ton truck loaded, 13 miles, and five-ton truck loaded, 10 miles.
4. Trucks shall not carry weights in excess of those contained in a certain table, which is the most conservative table issued by any of the tire companies for their own protection.
5. No trucks to be wider than ninety-six inches.
6. No trucks to be longer than twenty-three feet, six inches over all.
7. No trucks to be higher than twelve feet, two inches.
8. No metal tires shall be allowed on trucks, and no metal on tires shall be permitted to touch the surface of the road.
9. All trailers shall be equipped with rubber tires.
10. Not more than one trailer to be allowed.
11. Every truck should be equipped with sealed governor.

As counsel for the Motor Truck Club of America, we appeared at a public hearing and protested against many of the proposed changes, and have obtained another hearing at which we can present facts and figures upon which we base our objections.

Will you please be kind enough to look over the recommendations proposed and let us know which, if any of them, affect you, and how, giving us the name of the truck, number of trucks affected, and details as to how affected?

There was a meeting of the Motor Truck Club at the Automobile Club of America, on October 18, at 8:00 p.m., at which time the subject of legislation pending in New Jersey, New York, and adjacent States, was considered.

At this meeting there was present, Mr. Eugene Stern, Chief Engineer of the Bureau of Highways, Borough of Manhattan, who showed lantern slides and gave a talk on the manner in which heavy motor trucks have affected pavements in New York City.

Very truly yours,
COULTER AND BOND,
Attorneys for Motor Truck Club of America.

* * *

The Chain Belt Company, of Milwaukee, Wisconsin, has appointed Mr. C. F. Messinger manager of their Concrete Mixer Department.

Mr. Messinger has for years managed the Advertising Department, and is thoroughly acquainted with the mixer business. He will take charge at once and will augment the service features, which has always accompanied Chain Belt Mixers.

Mr. Messinger is a graduate of the Sheffield Scientific School of Yale University, and is well known by mixer men throughout the country.

* * *

The John Kline Brick Company, Wickliffe, Ohio, is the newest and the thirty-fourth member of the Dunn Wire-Cut Lug Brick Company's family of licensees. This is a well-constructed and well-managed plant with a daily capacity of forty thousand. It is a progressive company that makes a high quality of brick which has stood the test of service. Mr. J. C. Kline is president of the company, and he has high repute in the business world.




*Illustrating Our Sign in Use on the Cluster Light Standard in Front of City Hall, of Columbus, Ohio*

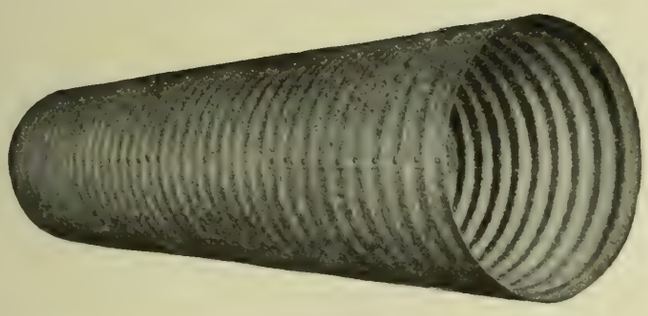
OUR GUARANTEE

A sign, the legibility of which cannot be destroyed by the most severe bending or striking test. A sign that is guaranteed against the cracking or breaking or deterioration from rust for a term of thirty years, on which the lettering never needs renewing. A sign on which the surface coating of the lettering and the surface finish of the plate may be renewed without removing the sign from the standard. A sign which can be refinished and made as good as new at any time at a cost not exceeding 20 per cent. of the original purchase price.

*Send for Our Booklet and Testimonials*

**The Indestructible Sign Co.**

**61½ Prescott Avenue** COLUMBUS, OHIO



**WHEELING ONE PIECE METAL CULVERTS**

*Made of Portsmouth Iron*

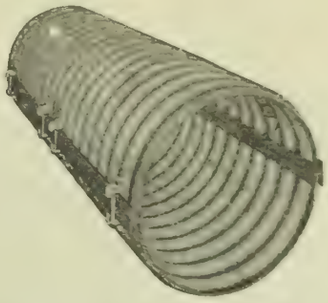
Measured by the strict rules of performance—another good interpretation of service—they are found even better than we claim them to be. We put so much into them you are bound to get more out of them. Write for prices.

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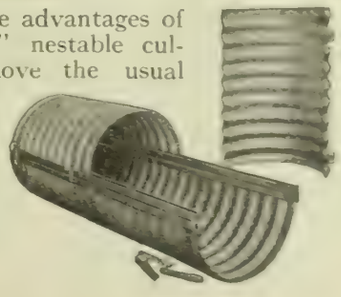
**Performance is the one Judge of Efficiency!**



**"CORCO" Channel Nestable Culverts**

(PATENTED)

Afford all the advantages of "knocked-down" nestable culverts and remove the usual difficulties in the assembling operations. They are simple in design and therefore simple to set up on the job.

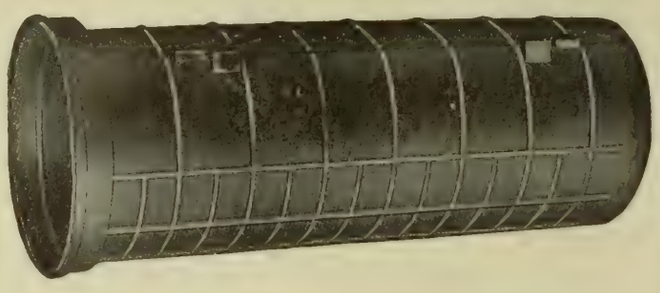


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## Burch Expansion Cast Iron Culvert Pipe



8 to 48 inches diameter, 3 and 4 ft. lengths. Half sections which lock with lugs.

Provides for expansion and contraction. Easy to handle and lay in ditch. Requires less excavation. Strong and durable. Send for Catalog "F" giving full description of complete line.

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Years ago the makers of Mogul and Titan tractors realized that if there was to be cheap power for building roads, it must come from the lower priced fuels—not from gasoline. Accordingly, the keenest inventive minds and the best skill obtainable were put to the task of designing tractors that would use kerosene as well as or better than other tractors operate on gasoline and at the same time do the most reliable work. The Mogul and Titan kerosene tractors are the successful result as experienced road commissioners and contractors know.

That is why you will find in every section of the country today, wherever highways are being bettered, International Harvester tractors in the following sizes, rendering uniform lasting good service: MOGUL 8-16 H.P., TITAN 10-20 H.P., MOGUL 12-25 H.P., TITAN 15-30 H.P., and TITAN 30-60 H.P.

Possibly your road maintenance costs are higher than they need be. Perhaps a little investigation would pay. Would you like to see some of the figures we have collected—some of the savings we have helped other contractors and road builders to make by changing over to Mogul or Titan kerosene tractor power? They'll cost you nothing but a two-cent stamp and a little time. Write for them.

## International Harvester Company of America

(Incorporated)

152 Harvester Building CHICAGO U S A


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## Portable Asphalt Plants for Country Roads and City Streets

(*Continued from page* 8.)

cement. The lack of fine materials was frequently made up by the addition of a small percentage of Portland cement or limestone dust.

*Material Per Batch.*—Each batch contained four hundred pounds of stone, two hundred pounds of sand and sixty pounds of asphaltic cement, a total of six hundred and sixty pounds.

*Moisture.*—The sand was taken directly from the river and was entirely saturated. The stone was frequently covered with ice.

*Maximum Capacity.*—On several days of ten working hours, 138 tons of material were turned out.

*Average Capacity.*—Per eight-hour day, the average capacity was one hundred tons.

*Maximum Daily Yardage.*—Based on the above maximum capacity and on two-inch finished pavement weighing two hundred pounds per square yard, 1,380 square yards were laid during a ten-hour day.

*Average Daily Yardage.*—Based on the above average capacity and on two-inch finished pavement weighing two hundred pounds per square yard, 1,250 square yards were laid per ten-hour day.

The city of New Bedford, Mass., operates one of the portable eight hundred square yard, two-unit plants, electrically driven, and from reports received, has no difficulty whatever in obtaining one hundred square yards of finished, two-inch sheet asphalt topping per hour. Practically the same report has also been received from the General Supply and Construction Company, York, Pennsylvania, which also owns and operates on contract work, one of the same size plants.

* * *

The value of the street maintenance policy that has been in vogue in Philadelphia for the past several years, or since the affairs of the Bureau of Highways and Street Cleaning were taken charge of by William H. Connell, present chief of the bureau, about four years ago, is being most emphatically and clearly demonstrated this year. Were it not for the excellent system of maintenance that has been worked out by Chief Connell, and which he has had in successful operation for more than three years, the streets and country roads of the city of Philadelphia would to-day be in bad shape, and would represent a financial loss of many hundreds of thousands of dollars to the city.

Because of the unusual conditions that prevail this year in the labor and in the material markets, from which the East suffers more than any other section of the country, work on which bids are being received this summer is costing at least forty per cent. more than it did last year, and it is, in reality, hard to get work done at all, or at any price. The contractors in and around Philadelphia report that they are experiencing a great deal of trouble in securing laborers at any reasonable price, and that to make matters still worse, it is getting more and more difficult to secure materials, especially when they are shipped by water, as much of the road-building material in this section of the country is shipped in this way. Where the charges for water shipment of road materials were formerly about twenty-five cents per ton on the average in the Philadelphia district, the charges are now a dollar a ton minimum, and frequently run considerably over this figure.

This condition of affairs, Chief Connell states, is not only affecting the work that is under contract, but also the very large amount of work that he has done by the municipal forces. Up to the middle of August this year, Chief Connell has only been able to get about sixty per cent. of the bituminous surface treatment work on macadam country roads completed, while in other years, under normal conditions, all of this work has been completed by the middle of July. It has, however, been simply impossible for the city, even paying the higher wages demanded, to secure the number of men required for this work, or to secure the materials as regularly and promptly as heretofore. But in spite of these hindrances, the highways, and particularly the hundreds of miles of country roads within the corporate limits of the city of Philadelphia, are in good condition. This is attributed to the persistent and careful system

of maintenance that has been worked out, whereby the roads are never permitted to get in bad shape, and are repaired as soon as it is seen that they need it.

* * *

Below we give a portion of a letter from Mr. W. H. Kestin, Sales Manager of the Northwestern Steel and Iron Works, Eau Claire, Wis. This letter is dated at Seattle, Washington, September 27, and refers to observations on business conditions and prospects made by him on his trip to the Pacific Coast. It is possible that you may find part or all of this information of enough general interest to your readers to warrant its use in your columns.

"My first stop was at Billings, Montana, where I found building conditions exceedingly good. The hardware and building material firms report conditions exceedingly favorable, and the country very prosperous. There seems to be a tone of optimism underlying all plans for future development, because of the very favorable prices which the farmers are receiving for their products. On the day I left Billings, No. 1 Northern Montana Wheat was sold at $1.72 per bushel in the Minneapolis market.

"My next stop was at Butte, Mont., where the whole trend of opinion is based on mining possibilities and profits. In the mining districts of western Montana and Idaho, carpenters are drawing seven dollars per day of eight hours, plumbers, eight dollars, bricklayers, plasterers, and lathers, nine dollars per day, while every man who desires work can obtain it in the mines, which are running three shifts in twenty-four hours, at $4.50 per day. Thus with every man employed, the outlook is a stirring one, and justifies the opinion generally expressed that this particular section is due for an era of considerable prosperity. Buying is done freely, but the persistent question is, 'How soon can you make delivery?'

"My next stop was Spokane, Wash., where the streams of prosperity find their sources in the Coeur d' Alene mining district and the Washington irrigated farms, as well as the Palouse wheat district, all of which report a high tide of prosperity; consequently buying is being done freely in Spokane. There has been an era of over-expansion in some lines, but the quiet years of 1912, 1913, and 1914 have about taken up the excess building and booming. The good road work, under the stimulus of cheap automobiles and general prosperity, is developing suburban districts adjacent to these cities, so that there is a very fair demand for all the materials entering into better class houses.

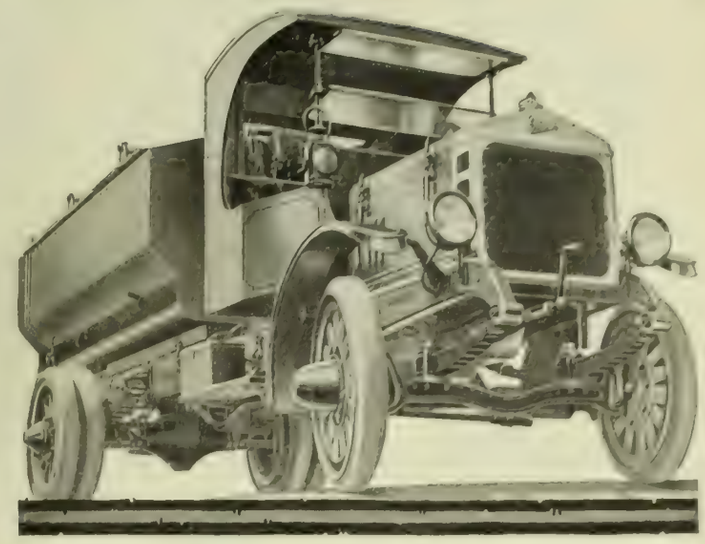
"The cities of Seattle and Tacoma are just emerging from three years of quiet times. Being located so far away from the manufacturing sections of the East, they have been unable to share in the general prosperity incident to 'war bribes' and war order prosperity excepting as it is felt in the increased transportation and handling of freight by the railroads at their terminals here of such freight as is sent through to the Orient. Both these cities are ports of call for Oriental steamers handling a large volume of freight across the Pacific.

"The increasing development of Alaskan business, due to the opening of new mines and other undertakings by private individuals, as well as the Government, added to the new prosperity brought about by shipbuilding conditions which are now at high tide, all make the immediate prospect of good times seem near. The shipyards of Seattle have contracts in hand for the construction of steamers whose cost will total thirty million dollars, and the yards at Tacoma are in the same prosperous condition. There is a lot of suburban building and development work being done, and in all probability the territory tributary to these cities will feel the rising tide of prosperity in real earnest with the coming spring."

* * *

The unusual number of manufacturers and producers of building materials and concreting equipment who have already made application for space at the Tenth Chicago Cement Show, makes it highly probable that builders who attend the 1917 show will find an even wider range of products and equipment than was presented at the Ninth Show. In addition to the standard machines that will be displayed, a number of the better of the new machines and devices which have been developed since the last show will be on exhibition.

Every possible effort is being made by the show management to conserve the available space in order to accommodate



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Sizes 2½, 3½, 5 and 7 tons.

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**Wilmington, Delaware**

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It is the oldest and best class of road construction in Europe and America.

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Get the facts before adopting your specifications.

Write us for information on stone and slag macadam, water-bound, or treated with asphalt or tar.

We can make delivery of crushed stone or slag in all parts of Northern Ohio, Eastern Ohio, Northern Indiana, and Southern Michigan.

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as large a number of applicants as possible. Exhibitors have been requested to make application for the minimum amount of space in which their exhibits can be installed, and the arrangement which eliminates the drawing for space and permits the management to make direct assignments, should do much toward saving space and making the show truly representative of the industry.

The Joint Exhibit of Cement Companies at the Tenth Show will, in all probability, excel the last exhibit in real educational value. Cement manufacturers have contributed more money for the exhibit and the plans to show concrete products in the making should make this exhibit worthy of careful study. The following Portland cement companies have already signified their intention of participating. It is probable that several other companies will also be represented.

Aetna Portland Cement Company.
Alpha Portland Cement Company.
Burt Portland Cement Company.
Chicago Portland Cement Company.
Crescent Portland Cement Company.
Diamond Portland Cement Company.
Dixie Portland Cement Company.
Huron Portland Cement Company.
Wyandotte Portland Cement Company.
Ironton Portland Cement Company.
Kosmos Portland Cement Company.
Lehigh Portland Cement Company.
Louisville Portland Cement Company.
Michigan Portland Cement Company.
Newayg Portland Cement Company.
New Egyptian Portland Cement Company.
Northwestern States Portland Cement Company.
Peerless Portland Cement Company.
Peninsular Portland Cement Company.
Union Sand and Material Company.
Universal Portland Cement Company.
Wabash Portland Cement Company.
Wolverine Portland Cement Company.

The American Concrete Institute will convene in Chicago at the Hotel La Salle, February 8, 9, 10, 1917.

* * *

## Press Notice

Photographers both professional and amateur, can find a good market for a certain class of pictures by addressing the Portland Cement Association, 111 West Washington Street, Chicago, and requesting details of a photographic competition which the association is now conducting. A number of cash prizes for best pictures received will be offered, in addition to which all prints received that are suitable for advertising or booklet illustrating will be purchased at a fair price. Write the Portland Cement Association for particulars.

* * *

CORRUGATED CULVERT SALESMAN WANTED—Effective on or before January 1. Must positively be experienced in this line; one familiar with Ohio, Pennsylvania, and Indiana territory preferred. The Canton Culvert and Silo Company, Canton, Ohio.

* * *

## Fellowship Established for Asphaltic Research

With the co-operation of Harvard University and the Massachusetts Institute of Technology, the Barber Asphalt Paving Company has established at these institutions a fellowship for research in asphaltic materials and their uses. The fellowship is to be known as "The Clifford Richardson Fellowship." Mr. Richardson is a distinguished alumnus of Harvard, and this, taken in connection with his great contributions to asphaltic highway construction and his work in the chemistry of bitumens, makes the designation of the fellowship particularly appropriate. The appointment of the incumbent of the fellowship and the choice of subjects for investigation, as well as the disposition to be made of the results of such investigations as may be undertaken, are to be decided by the institute faculty or the joint committees of the university and the institute having control of engineering work.

625.05 Civil eng.
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# BETTER ROADS AND STREETS

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DECEMBER, 1916

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GARFORD MOTOR TRUCKS are the sturdiest, staunchest vehicles we have been able to develop in ten years devoted exclusively to that one purpose.

They are brutes for work—yet quickly and easily handled; powerful—yet economical of oil and fuel.

Above all, they are thoroughly and unquestionably dependable.

They are built in different styles and sizes to meet the most exacting demands in the contracting field.

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4½, 7 and 10 ton Tractors
Distributors and Service Stations in all Large Cities

# Better Roads and Streets

VOL. VI. NO. 12 DECEMBER, 1916 PRICE FIFTEEN CENTS

# Portable Asphalt Plants for Country Roads and City Streets

## Descriptive Article No. 3

By George D. Steele

THE HETHERINGTON & BERNER PORTABLE ROAD PLANT.

THE third plant to be described in this series of articles on Portable Asphalt Plants is the well known one manufactured at Indianapolis, Indiana, by Hetherington & Berner, a large number of which are in use in practically every section of this country. These plants are found on the Atlantic Coast, on the Pacific Coast, in our Lake States, Canada, the great Middle West, and throughout the South.

The plant manufactured by Hetherington & Berner is the latest development and the result of thirteen years' work and experimentation with plants of the portable type. The first plant was built in 1903, and was of the two unit type, the drier being one unit and the melting kettle as the second unit. In the case of this early plant, the mixer was mounted on a bridgeway, or platform, midway between the melting and the drying units, which arrangement provided for a driveway underneath the mixer, facilitating the loading of the material into wagons with a minimum of loss of time and handling. Both of the units were mounted on wheels and were provided with tongues so that they could easily be drawn by horses and moved from place to place as occasion and the work demanded. This early plant was not quite as portable as the plants of present day manufacture on account of the mixer platform being located as stated between the two units on the assembled bridgeway. In spite of this seeming disadvantage, the plant proved, however, an eminent success, but was used for city paving work only. On its first contract, which called for 28,000 square yards of surface, it finished the work at an average of eight hundred square yards per day for actual operating time. This work was standard sheet asphalt surface with the usual one-inch binder course.

The plant was moved about from one place to another by the owners, and within the past three or four years the wheels and axles have been removed and the plant was set up on foundations as a stationary plant, in which shape it is still in operation.

This plant, of course, preceded by some years the agitation and the demand for good roads, and it was simply the purpose of the designers and builders to furnish a small plant which would turn out the required amount of work at the right operating cost, and which could be easily moved around from place to place at a minimum cost, and also be moved from one small town to another as contracts for paving were secured, and located at points where the railway type of plant could not be located and used to advantage. At the time of the conception of this small portable plant, the asphalt paving industry had not been taken up by the smaller street and road paving contractors as it has been in these days, and those contractors who were well established in this business and usually had many thousands of yards of work contracted for ahead for each season, were usually found to be entirely in favor of the large capacity plants. They frowned upon the smaller plant of the portable type as being bad for the business, meaning of course that this plant, if marketed commercially, would mean more competition for them by making it possible for the smaller contractors to engage in sheet asphalt work, whereas they had been kept out of it before on account of their inability to afford to purchase the large railway plant.

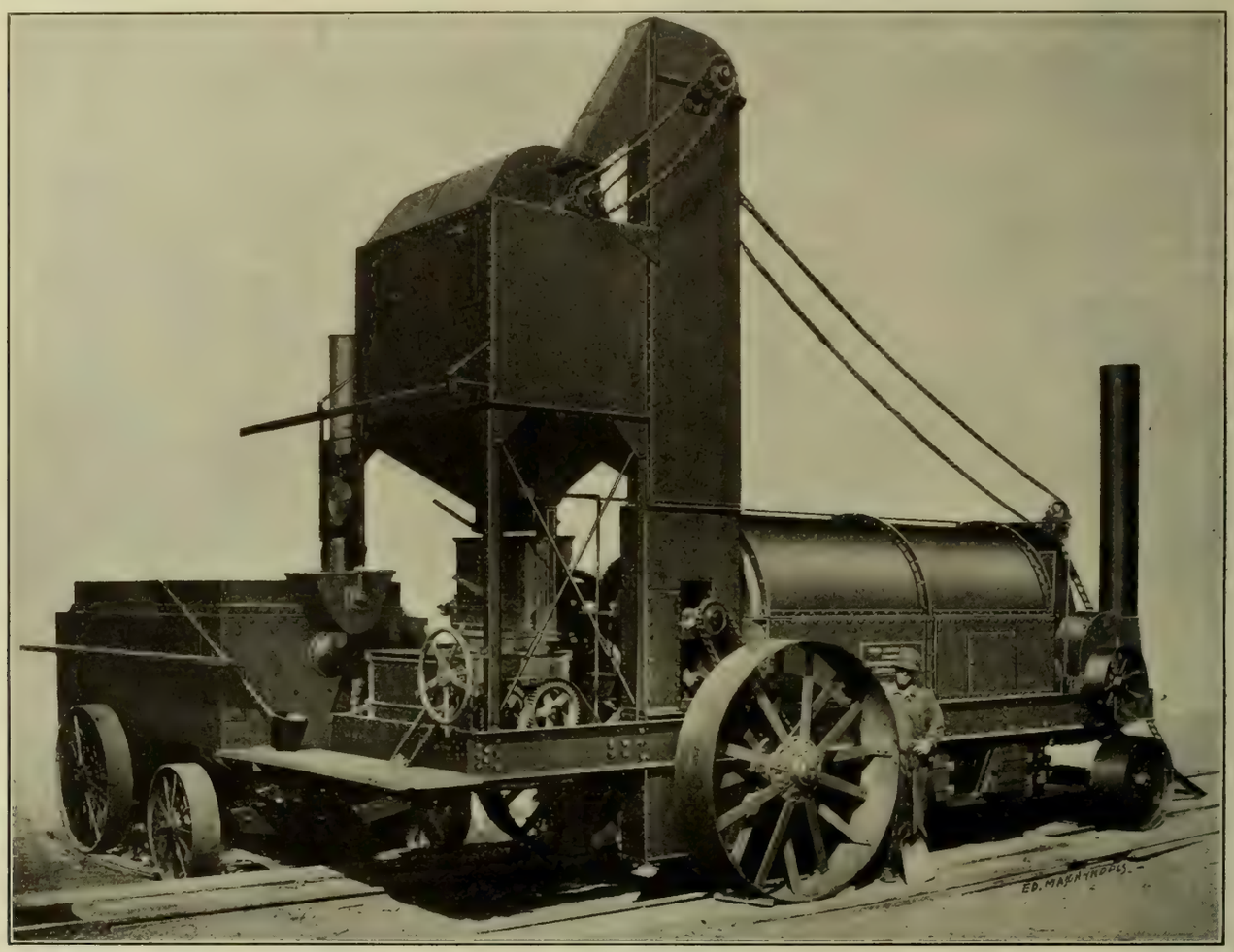
Therefore, there was little done by the manufacturers toward placing this portable plant on the commercial market, and it was not until about four years ago, when the increasing demand for bituminous roads seemed to justify it, that the



SHOWING THE HETHERINGTON & BERNER ROAD PLANT AT WORK
As shown in this picture the plant is operating with but one Melting Kettle; when operating at full capacity, two are used

idea was again taken up by Hetherington & Berner. This concern then experimented with plants of various construction, having in mind the production of a plant of the least possible weight and with the greatest possible capacity. Experimental plants were produced which carried their own engine and boiler. Others were equipped with gasoline engines for driving. Still others had the melting kettles integral with the dryer and mixer unit, thus forming a complete plant on one frame-work—truly a one-unit plant. All of these various types were found to be impracticable, and were soon abandoned, although not until they had been thoroughly tried out, for the present type of plant. This type of plant, the manufacturers believe to be the highest development in the art of road plant manufacture. Hetherington & Berner have abandoned the idea of attempting to place either the melting kettles or the power equipment on the same frame with the drying and mixing unit.

The Hetherington Road Plant, in its present form, consists of one steel frame carrying the dryer, mixer, feed elevator, hot material elevator, and hot material storage bin, with separate melting kettles, either one or two as desired and demanded, depending upon the capacity desired, mounted upon their own wheels, and each provided with its own tongue for hauling.



The Melting Kettle may be set at right angles to the plant, as shown in this photograph, if such an arrangement is found advantageous. Notice the large rear wheels.

This outfit has been made as light as it was deemed advisable for the class of service in which it may be used. The dryer unit is twenty-seven feet long over all, and, together with one of the five-ton melting kettle wagons, can readily be shipped on an ordinary thirty-eight-foot flat or gondola car. If two of the melting kettles are desired, it is usual to place the road plant on one car by itself and the two melting kettles, together with such fire wagons, hand tools, etc., as may be needed on the particular work in connection with the plant, on the second or trailer car. The dryer unit weighs about seventeen tons and each of the kettle wagons approximately eight thousand pounds. The entire two-kettle outfit can be shipped to any distance at a freight charge based on a minimum car of fifty thousand pounds.

When set up for operation, the kettle or kettles, as the requirements may be in each particular case, are usually set in line with the dryer unit. The mixer is located on the dryer unit at the end of the frame work, which overhangs sufficiently beyond the rear axle to allow plenty of clearance for a wagon directly under the discharge from the mixer. In order to keep the center of gravity as low as possible and to reduce vibration in the plant, the mixer is so constructed that it is set in the main frame work, and still allowing a space of thirty-nine inches above the ground level. The plant may be run up on the blocking for a height of twelve or eighteen inches and a driveway of about eighteen inches depth scraped out beneath the projecting mixer end of the plant so that the wagons or trucks can be driven underneath, and the mixer therefore discharged directly into the vehicles that will haul the material from the plant to where the work is being done.

For driving the plant, it is customary for the contractor to furnish a portable overmounted engine and boiler of from twenty to twenty-five horsepower capacity, which is set in line with the plant and drives by means of a belt to the main driving pulley at the feeding end of the plant. A road engine or a traction engine is most desirable for driving the portable road plant, as in such cases, this engine can also be used in hauling the plant around when it is necessary to change its location. However, if the contractor does not wish to go to this additional expense, and has available the horses to use for this purpose, they may be used in hauling the plant, as the manufacturers provide a heavy tongue for this purpose. Six horses can readily haul the plant under ordinary conditions, while four horses have been found all that were necessary in hauling the plant over improved city streets.

A feed elevator, adjustable as to length, extends out from the forward end of the plant. When moving the plant, this elevator may be quickly felded back against the plant without the necessity of dismantling it. The material is fed to the foot of this elevator, and is delivered to it through a direct chute into the dryer. After passing through the dryer, it discharges into the hot material elevator, which carries it

overhead and delivers it to a screen in the top of the storage bin. The mixer is mounted directly under the storage bin, and a weighing box, mounted on a platform scale, is interposed so as to receive the material as it is discharged from the bottom gates of the bin. The asphaltic cement is brought to the mixer in the weighing bucket which is suspended from a dial scale in a frame which is hung from a trolley rail overhead. This trolley rail is hinged from the sand bin like the boom of a crane, so that it may be swung through an arc of 180 degrees, thus allowing the melting kettles to be set at either end of the dryer, or at the end in line with it.

The mixer operator stands on a platform at the end of the dryer unit and all of the mixing operations are under his direct control. Levers are provided controlling the discharge gates from the material bin, and the mixer discharge gate is operated by a hand-wheel at the front of the mixer. The asphalt weighing bucket may be moved from the mixer to the kettle without causing any inconvenience to the mixer operator.

The mixer and dryer unit is of exceptionally sturdy construction. The main frame is constructed of fifteen-inch channels which admits of the plant being operated with a minimum of vibration and without the use of jacks, which it is ordinarily necessary to use for absorbing the vibration in the case of the railway plants. Nearly ninety per cent. of the entire load of the plant is carried upon the rear axle, which is the axle adjacent to the mixer end of the plant. This axle is of solid cast steel of I-beam cross-section at the center, and has wheel journals four and three-quarter inches in diameter. It is so made as to not only support the weight of the plant, but also to act as a rigid tie member in the side frame. The rear wheels, which are mounted on this axle, are seventy-two inches in diameter, and for use in the northern sections of



**Feeding from the end of the plant. The elevator may be arranged for side feeding if desired.**

this country have tires three-fourths of an inch thick with faces fourteen inches wide. The large diameter of these wheels adds greatly to the portability and stability of this plant, and also greatly reduces tractive effort in hauling. The front wheels, which carry but little over ten per cent. of the total weight of the plant, are thirty-four inches in diameter, and like the rear wheels, are of exceptionally sturdy construction. Each wheel has two thirty-three inch flanged steel heads forming the center webs. The tires are of five-eighths-inch steel with faces fourteen inches wide. The front axle is of cast steel made in box section, and is connected to a cast steel frame bolster through a swivel center bearing which permits of vertical movement as well as providing for swivel action. The bolster just referred to is of cast steel and is of similar design to the truck bolsters of railway freight cars. The main frame is strongly braced with structural members and one cannot but recognize the same sturdy construction that is found throughout this plant, and which is characteristic of all Hetherington & Berner Asphalt Paving Plants.

The manufacturers called our particular attention to the dryer on this portable road plant, as this is really the heart of all paving plants. The drum is five feet in diameter and the shell portion, exclusive of the end rings, is eleven feet long. The drum is mounted entirely within an enclosing steel plate housing which is lined with fire brick and other refractory materials. The fire box is located directly beneath the drum and toward the feed end, and furnishes more than thirty square feet of grate surface. The heat from the fire box completely surrounds the drum, passing its full length and entering the drum at the discharge end, thence repassing the full length within the drum and is withdrawn through an exhaust fan which is mounted in the frame at the feed end. It will thus be observed that the greatest possible heating efficiency is obtained in this manner, and furthermore, due to the contrary movement of the hot gases relative to the material passing through the drum, the moisture laden gases are not made to pass over material which has already been dried. It is, therefore, possible with this dryer, even when operating it in rainy weather, to not only perfectly dry, but to attain a temperature of nearly five hundred degrees Fahrenheit, if necessary, without ruinous forcing of the dryer. The fire box is lined with fire brick when it leaves the shops and it is, therefore, not necessary to do any construction work upon the arrival of the plant at its destination.

The heated material from the dryer is delivered to the boot of the hot sand elevator, and in the bottom of the chute delivering to the boot is provided an automatic discharge gate so that, should the boot become clogged for any reason, or the elevator be stopped, the weight of the accumulating material in the chute will automatically open the gate and allow the material to be discharged. The bottom of the boot, however, is open, as it has been found most desirable to allow the material discharged from the chute to form its own boot at the bottom of the elevator.

The elevator consists of the usual Link-Belt chain with malleable iron elevator buckets attached to the chain at intervals of sixteen to twenty inches. The chute from the head of the hot sand elevator delivers into a deflector chute which, in turn, by manipulation of either of two levers, may be made to deliver into the screen or directly into the bin, or to discharge the material without its entering the bin, as might be desirable should the material for any reason become too hot to use.

The screen is of the cylindrical revolving type, and for the first half of its length consists of eight-mesh No. 18 gauge material. The balance of the screen is five-eighths inch mesh No. 10 gauge material, these two sizes meeting the usual specification requirements.

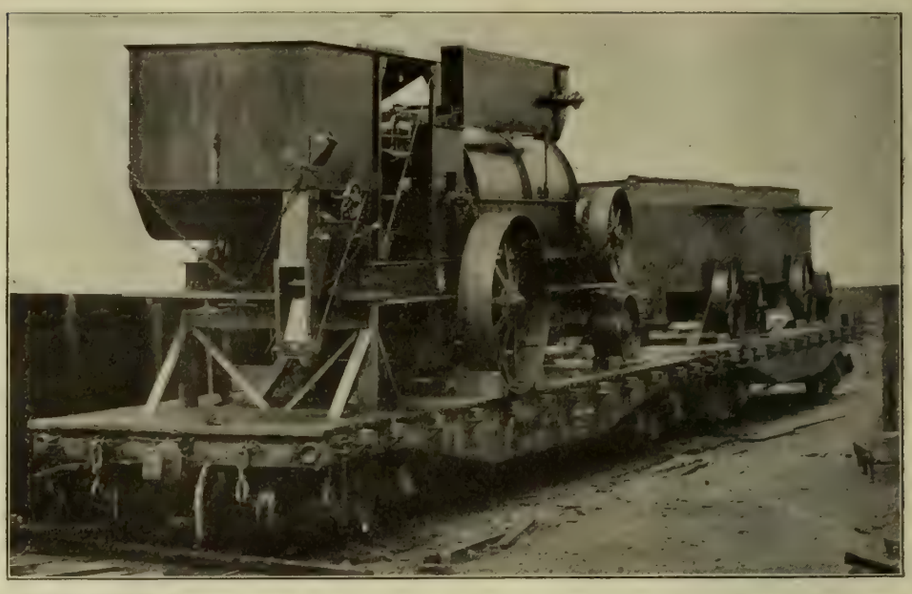
Beneath the discharge end of the screen is a tailings chute provided with a deflector gate so that, should it be advisable, the tailings may be turned into the bin instead of being discharged therefrom. The bin has a working capacity of about five tons and is provided with a hinged partition dividing it into two compartments. One of these compartments is for sand and the other is for stone. If standard sheet asphalt surface is to be laid, the partition may be hinged back, thus allowing the entire cubical contents of the bin to be used for the sand alone. Similarly, if laying binder, the deflector chute may be set to discharge directly into the bin, in which case the entire bin can be filled with the binder stone. The entire top portion of the bin is hinged on one side to the hopper portion beneath, and may be lowered to a position giving sufficient road clearance for shipping on the ordinary freight car. A pipe mast with blocks and rope are provided for raising or lowering the bin, and this is usually done by three or four men on the rope. The hot sand elevator is also hinged at a point which gives ample room clearance when the elevator is lowered for shipment. The many admirable features of this bin, such as the hinging, the deflector chutes, etc., are all protected by patents, as they are of great convenience and value to the contractor.

The mixer of six cubic feet capacity—that is, it is designed for a batch using six cubic feet of aggregate, and it handles a mixed batch of seven hundred pounds without difficulty. The mixer is driven by sprocket and chain from a main jack shaft supported by the frame work and is not in direct geared connection with any other working element of the plant. Should the mixer become jammed through any accidental cause, the driving chain would break and thus protect the more vital working parts. The discharge from the mixer is effected through one center opening having a slide gate operated by rack and pinion, and a large diameter hand-wheel mounted on the front side convenient for the operator. Two sets of shafts are ordinarily provided with the plant, as the contractor may be called upon to change blades on standard sheet asphalt work when changing from binder course to topping, but ordinarily for bituminous concrete work but one set of shafts

and blades is necessary. The change is very rapidly effected in the Hetherington mixer because of the removable mixer side plates which allow the shafts to be removed complete with their equipments of gears and blades.

The power transmission parts of the plant are designed with a view to simplicity in case of needed repairs. All bearing boxes are provided with removable caps and are babbited. There are no bronze bushings used, so that when a bearing is worn it is only necessary to re-babbitt, which can readily be done by any ordinary mechanic, and it is not necessary to renew shafts which would otherwise be worn out by the use of bronze bushings.

Both the dryer and the mixer are connected to the main driving jack shaft through chain drives, thus affording the desirable flexibility of the parts of the plant when it is being moved over rough and uneven roads, and the most desirable feature of absorbing shocks or back lash of one part without damage to other connected parts. Steel roller chain is used for the heavier drives, while for the lighter drives, malleable iron pintle chain of standard makes which are easily renewed in any part of the country, are used.



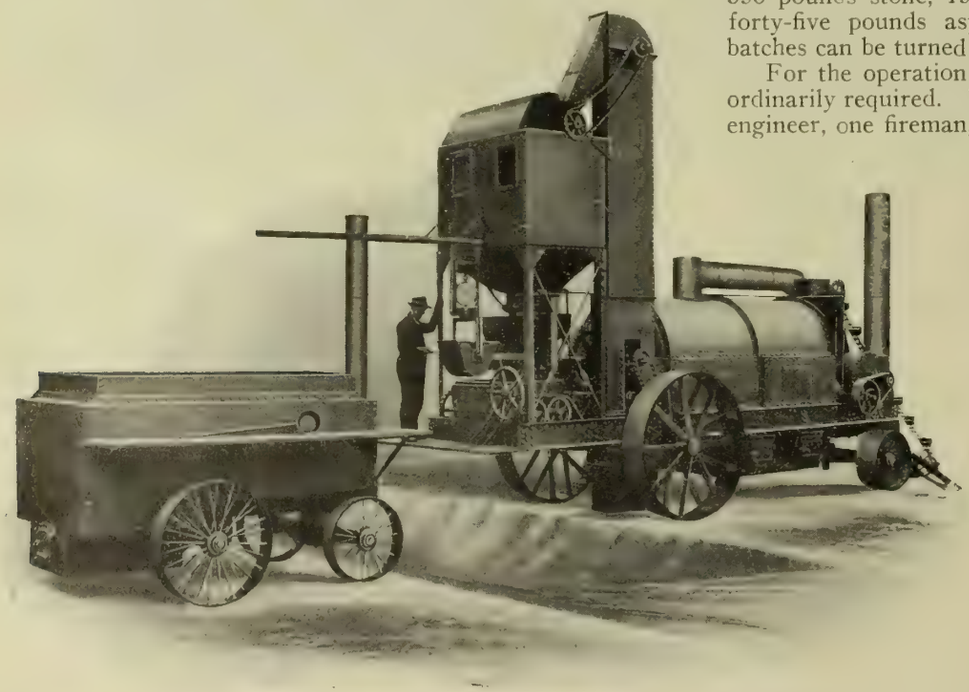
The Two-Kettle Plant loaded on flat cars. The one-kettle plant may be shipped on one car only Note the turn-down bin and elevator

The melting kettles used in connection with the plant are of five-ton capacity, and have a working capacity of one hundred and eighty cubic feet. The kettles are supported in a steel plate housing so that all four sides, as well as the bottom, are exposed to the heat, thus insuring rapid-melting kettles. The kettles themselves are nine feet long and are constructed of one-fourth-inch boiler plate steel. Slanting hinged sheet iron covers are provided over the tops of the kettles, and are made as water-tight as it is possible to make them. The housing surrounding the kettles are made of No. 6 gauge plate, and are lined with asbestos material to conserve the heat, and to save the housings from damage by the heat. Working platforms of wood are supported on steel brackets at two sides and one end of the housing. The height of the kettles is such that when the asphalt weighing bucket is moved to position over them, the material may be readily dipped from the kettle to the bucket. Two nine-quart dippers are furnished with each kettle.

The contractor may be able to get along with but one kettle, but it has been found desirable to employ two in order to be able to work up to the full capacity of the plant. To the contractor who is accustomed to the refinements of the railway or the stationary plant, the dipping method of the handling of the asphalt seems crude. For those desiring better means, the manufacturers can furnish their steam-jacketed centrifugal asphalt pump and a pipe line to the mixer, but the additional expense and the complication that are involved are not deemed justifiable in a plant of this type by most contractors doing road work.

The Hetherington & Berner Company sells their portable road plant on a capacity guarantee of one hundred square yards of standard two-inch sheet asphalt surface per hour, but on bituminous concrete work, for which the plant is in most cases required, it has been repeatedly demonstrated that the capacity will run from one hundred and thirty to one hundred and forty square yards per hour. For this reason the manufacturers advise that the contractor purchase two melting kettles at the beginning, in order that the material may be turned out rapidly enough to insure the sand and stone being not overheated. When the batches are being mixed in the proportion of about 350 pounds stone, 150 pounds sand, thirty pounds dust, and forty-five pounds asphaltic cement, a wagon load of nine batches can be turned out every eight minutes.

For the operation of the plant, from eight to ten men are ordinarily required. This force consists of one mixer man, one engineer, one fireman, two or three kettle men, and from four to five laborers for feeding the elevator and for general use about the plant.



By excavating a driveway as here shown it is not necessary to elevate the plant

The advantages claimed by the Hetherington & Berner Company for the plant that has just been described in rather complete detail are as follows:

1.—The batch pug-mill type of mixer with two sets of shafts and blades adapts the plant for any class of bituminous material. Many specifications do not allow rotary drum mixing, as in the case of all hot mixers.

2.—The motive power, that is the engine and boiler, the gasoline engine, or the electric motor, are not a part of the plant and are not furnished with it. The contractor may thus provide his own power. This keeps down to a minimum the weight of the plant, and adds to the life of the power plant.

(*Continued on page* 30)

# The Passing and Conservation of Macadam City Streets and Country Roads*

By George C. Warren, Boston, Mass.

THE present condition and generally accepted opinion of experts is well put in the following, extracted from the *Engineering News,* issue of August 3, page 226:

"Because of her early activity in road construction New Jersey has expended many millions of dollars in the construction admirably suited to the horse-drawn traffic which existed at the time the roads were built, but wholly unsuited to the motor traffic of the present day. The various makeshifts that have been tried during the past decade to enable a water-bound macadam road to stand motor traffic have involved large expense and have generally proved unsatisfactory in service. Fortunately, the last few years have seen the development of types of road surface which can withstand the stress of motor traffic and whose first cost and cost of maintenance are not prohibitive."

The speaker, however, is not one of those who argues or believes that macadam is useless, as a new construction for certain classes of roads, or that old macadam must be torn up and "wasted" to make place for a new and modern construction. He, however, does state the very firm conviction, based on broad and varied observation and experience, that macadam, whether water-bound or bitumen-coated, is not adequate to economically or satisfactorily withstand the *present* traffic of the automobile thoroughfares, which constitute probably more than seventy-five per cent. of the city streets and country roads throughout the United States and Canada.

He is firmly convinced that such roads not only will not withstand the ravages of the *motor truck of to-day, but much less that of the very near future,* and also believes that the motor truck which, during the past three or four years, has developed by leaps and bounds, is destined, in a very few years, to be as many fold more severe than the auto pleasure vehicle traffic of to-day, as the latter is to-day more severe than the horse-drawn traffic of only fifteen years ago. We must build for the future—not merely for the present—and the engineers and road and pavement builders must appreciate, as they generally do not yet fully appreciate, that road construction must be as drastically improved as the stress on the road has been and is being drastically increased by the advent of motor pleasure vehicles and trucks. The fact is that to-day the average narrow country thoroughfare carries more and more severe traffic per foot of width than the average much wider city street, and yet "makeshift" constructions are being generally adopted on country roads, the adoption of which would not be thought of on city streets subjected to much less severe traffic.

It is a problem which must be met, and liberally and drastically met, not only by villages, cities, counties and States, but by the federal government. The recently passed federal act which appropriates increasing annual amounts ($5,000,000, $10,000,000, $15,000,000, $20,000,000 and $25,000,000, or a total of $75,000,000) to be expended during the next five years on post roads, at a cost to the government of not exceeding $10,000 per mile, provided the State will at least double the amount on each road, making a total of $150,000,000 or more, is only "a drop in the bucket," but is a good start in recognizing a *necessity*—"a condition and not a theory which confronts us."

New York State expended the proceeds of a $50,000,000 bond issue in State highway construction during a few years prior to and including 1912. The expenditure of the proceeds of a succeeding $50,000,000 bond issue is now nearing completion and during the past four years has been very largely used in reconstruction of roads built but one to four years before. The speaker predicts that many of the roads constructed in New York State during the past four years will have to be reconstructed within a very few years. In fact, many of them have already required practical reconstruction and now need the same. This, in the speaker's judgment, is not the result of "graft," but because the necessities of the case are not appreciated in the Empire State and the effort is far too much toward building the *greatest possible number of miles of road at a given expenditure, rather than to build as thoroughly as possible as far as the money will go*—the former a "penny wise pound foolish" policy.

That this situation in the Empire State is being appreciated by some is shown by published statements in that State.

The Kansas City, Missouri Journal of August 17, 1916, quotes Mr. George A. Ricker, formerly one of the Deputies of the New York State Highway Commission, as stating in a public address in that city—"In New York $4,500,000 were spent in the up-keep of roads already constructed during 1915."

The following from the New York Sun of March 24, 1916, tersely and forcefully illustrates the importance and economic necessity of building a better class of construction on country highways to enable them to successfully carry the modern auto traffic. The force of the statement is accentuated when it is known that Senator Elon R. Brown is the majority leader of the New York State Senate.

The New York Sun article is of special importance coming from the great State of New York, which has nearly completed the expenditure of the proceeds of bond issues aggregating $100,000,000 during the past ten years, by far greater part of which is of such cheap inferior types, as referred to by the Sun, which are absolutely inadequate to carry even modern and much less able to carry the surely prospective auto traffic.

(Extract from New York Sun, March 24, 1916.)

LOGIC OF THE ROAD BUILDER.

Senator Elon R. Brown, of Watertown, interrupted a hearing on Wednesday on a bill designed to do the square thing by this city, to say:

*The entire highway system of the State is in danger of being ruined by automobile trucks.*

*I had a conference with Edwin Duffy, Highway Commissioner, to-day, and he tells me there are highways within five miles of where we are that may be ruined within sixty days. .*

The "entire highway system of the State" we take to mean the State highways; and these were authorized, designed and constructed after the internal explosion engine became a fact that every road builder had to reckon with. *Were they, then, laid out without regard to the use on their surfaces of motor trucks? Was it supposed by their designers that such vehicles would avoid them, and run across lots? Or in their unsubstantial and unfit qualities is the State to learn another lesson in the science of politico-physics, with the later history of which they are so intimately connected?*

The New York Times, on April 24, 1916, published the following statements from Senator Argetsinger, another majority leader in the New York State Senate:

CALLS HIGHWAY FACULTY.

*State's Maintenance Problem Is Serious, Argetsinger Asserts.*

(Special to The New York Times.)

Albany, April 23.—*Senator George F. Argetsinger of Rochester, doubts whether the State will have a real highway system after the expenditure of* $125,000,000 by 1920. He has studied the highway problem and concludes that the maintenance of the highways is one of the most serious financial questions that now confronts the State. In discussing the matter to-day, Senator Argetsinger said: *"The people do not realize how serious the highway problem is even at this stage."*

Senator Argetsinger asserts that the State has yet to learn how to construct permanent highways. *Many miles of highways have to be entirely reconstructed and resurfaced each year, he says, and an expenditure equal to thirty per cent. of the construction cost will have been made by* 1920 *in the maintenance of the* 9,500 *miles of highways* which will then have been built. He believes that the present system of maintenance is faulty and requires immediate remedial legislation. He predicts a maintenance cost of $8,000,000 a year by 1920 unless the remedy comes.

*Prepared for the Annual Meeting of the American Society of Municipal Improvements Newark, N. J., October 10-13 1916.

The following is copied from the Utica, N. Y. Observer of Tuesday, August 15, 1916:

WASTEFUL ROAD BUILDING.

*The State's Highway Department Utterly Incompetent.*

Albany, in the language of its newspapers, is isolated from New York City by the almost impassable condition of about five miles of main road from Poughkeepsie. To enter the capital it is necessary to make a long dusty detour. This condition has existed since last year.

Incidental *inquiry made* in connection with the thorough investigation of State Highway work now in progress, *shows that the torn up stretch of road was plain macadam built two years before it was advertised for resurfacing in* 1915.

A little further down the road from New York there are several miles under construction near Blue Stores. This road is deteriorating at the finished end while construction is proceeding at the other end. *The new road is still a good road in the eyes of the motorist, but it already shows minor displacements that are sure signs of early disintegration.*

The road entering Albany is being built with the same inferior asphalt binder that is being used on the Blue Stores road. *There is no reason to believe, therefore, that the heavily traveled Albany road when completed will long remain in satisfactory condition.*

*The present highway policy of cheapness appears also to be infecting the towns.* Rhinebeck's principal street, among others on the main line between New York and Albany, reeks with tar spread with no prospect of any permanent result except the ruin of everything with which it comes in contact.

CONSERVATION OF OLD MACADAM.

This brings us to the second phase of the subject the speaker has been requested to cover by this paper.

In all said above regarding the inability of macadam (whether water-bound or surface treated) to sustain modern motor traffic and the importance of building the highest types of roads to meet the exactions of that traffic, the speaker is totally opposed to the commonly expressed thought that the old macadam must be wasted and a new foundation as well as new surface supplied. On the contrary, economic conservation demands that the old macadam be preserved, and, if too thin to provide a foundation for a new surface, build up on but never destroy the old macadam, and then surface with the very best available surface material.

It has been abundantly proven that this is true "efficiency and economy" and that there is no better foundation than well drained macadam which has been compacted by years of traffic.

In the speaker's home city of Boston, there are now in use approximately four hundred (400) miles of old macadam streets, practically all of which have been surface treated with oil or other materials. Fifteen years ago they were the pride of the city and an example for the country. To-day they are such a vast expense to maintain that the city's laws with respect to assessment and finance for pavement are at present such as permit of nothing more than to keep most of them in barely passable condition and occasionally renew a few, although the aggregate amount so expended in repairs is very large. It is estimated that it will require an expenditure of from twelve to fifteen million dollars ($12,000,000 to $15,000,000), to convert them into high grade modern pavements. It would cost nearly ten million dollars ($10,000,000), additional if the old macadam should be torn out and new foundation supplied. Nearly three years ago Marlboro Street, one of the leading East and West thoroughfares of the celebrated Back Bay District of Boston, had gotten in such shocking condition that its reconstruction had become a necessity. Bitulithic had been adopted by petition of the property owners and official action of the city, as the type of surface, and the question arose as to the foundation. Regrading and surfacing of the old macadam would cost approximately $25,000. To remove and waste the old macadam and provide new portland cement concrete base would have cost at least fifteen thousand dollars ($15,000) additional. The Commissioner of Public Works was skeptical of the plan of resurfacing the old macadam and quite insistent in providing new concrete base, notwithstanding the extra fifteen thousand dollars ($15,000) cost. The speaker's urgent recommendation to save the macadam and fifteen thousand dollars prevailed. The work was constructed utilizing the old macadam as a base, as reported in considerable detail in *Municipal Engineering* of August, 1914. Immediately the traffic more than quadrupled, taking most of the traffic from less improved parallel streets. The pavement is in its third year of use; has not the slightest settlement; has not cost a penny for repairs from any cause, and stands to-day in perfect condition, an indisputable instance of proof of the proposition that old macadam has much economic efficient use, even if it cannot economically sustain modern traffic as a wearing surface.

The following year a larger and equally prominent thoroughfare in another section was similarly treated and has proved equally successful. During the present year Commonwealth Avenue, from Arlington Street (opposite the Public Gardens), to Brookline Avenue, has been similarly reconstructed. A. S. M. I. members who attended the 1913 convention in Boston will particularly remember Commonwealth Avenue (a double roadway, each thirty-six to fifty feet wide with 100-foot parkway in the center), the westerly end of the work at Brookline Avenue being one block south of the Somerset Hotel, which was the official headquarters of that convention.

Turning to country roads, old macadam has been similarly surfaced during the past five years to the extent of over 300 miles in the States of Oregon, Pennsylvania, New Jersey, New York, Massachusetts and Connecticut alone.

It is reprehensible that the cement combination, officially styled the "National Portland Cement Association," representing practically every Portland cement producer in the United States, which has succeeded during the past two years in universally advancing the price of cement generally about forty (40) cents per barrel, say sixty (60) per cent., and which can get nothing out of the economic utilization of old macadam as a foundation for modern pavement surfaces, persistently opposes such economic use of the millions of dollars already expended in old macadam streets and roads. It is extremely unfortunate that with the billions of dollars which must necessarily be expended in all types of modern pavements and roads any organization or individuals, and especially one having the influence of an aggregation of over a billion dollars of combined capital, would oppose such an economic conservation of a comparatively small part of it, where macadam and other old pavements suitable for resurfacing now exist. It is well to here note that a recently issued official instruction to the cement representatives in the field by the National Portland Cement Association provides:

While we should industriously promote by education and otherwise, the construction of concrete pavements, roads, alleys, etc., *we should not spend much, if any of our time, in an effort to change other types of construction to concrete where those other types will, if built, be laid on a concrete base.*

Note the correlative of this is that they will oppose the carrying out of projects for street and road improvements and the issuance of bonds therefor, unless Portland cement is to be used in the foundation, and that the immense promotion fund provided by the large assessment against practically every barrel of Portland cement manufactured in the United States has been used for the purpose of so influencing legislation. What an unbearable situation would develop if the asphalt interests, the brick interests, the lumber interests, the stone interests, the gravel interests, etc., should each similarly combine and say to the public, villages, counties, cities, States and even the Federal Government, "If you do not accept our materials (respectively) we will politically oppose legislation and bond issues and to the best of our ability see that you get no pavement or road, nor bond issues to accomplish the end."

CAUTION.

While presenting proof of and urgently advocating the efficient and economic use of old macadam as a foundation for suitable new modern pavement and road surfaces, the speaker would fall far short of his duty if he did not add two important points of caution, to-wit:

1. Be sure the road to be surfaced has macadam worthy of the name.
2. Be sure that the road is suitably drained.

These points having been recently fully covered in an article by the speaker published in *Good Roads,* issue of August

(*Continued on page* 36)

# Legislation Proposed for Motor Trucks

What New York State, New Jersey and Michigan are Proposing for the Protection of the State Highways, with Pertinent Views from Both Sides on this All-Important Question

By George D. Steele, Associate Editor, Better Roads and Streets

ONE of the most important problems with which the officials of any of the highway departments in our populous States have to deal to-day is the question of protecting the highways from the destructive action of the automobile and the motor truck. It is only a few years ago, not more than three or four, that the entire blame for the destruction of our improved roads was placed to the credit of the automobile. The motor truck was common on our city streets, but it was seldom encountered on our country highways at any great distance from the large cities, excepting the average light trucks used by the farmers. Now, however, it is not possible to drive any distance over the country roads within several hundred miles of any of our large cities without meeting numbers of trucks of large capacity. Regular lines and routes have been established between cities fifty and more miles apart, and, most unfortunately, many of these trucks are loaded with several times their rated capacities, and are driven at fifteen, eighteen, and even twenty miles per hour. The effect on the roads that were never planned and built for such extreme traffic loads is soon apparent. The writer has seen a number of roads in the vicinity of New York City, Philadelphia, Pittsburgh, Albany, Baltimore, Cleveland, and Chicago that stood up well for a couple of years under ordinary automobile and horse-drawn traffic, but which in the past two years have been practically ruined by these trucks.

It must not be construed that the writer is opposed to the use of the motor truck on the country highways any more than he is opposed to this most important commerce carrier on our city streets. He does believe, however, just as does every other fair minded engineer and those who have charge of the construction and maintenance of our roads, that steps should be taken for the protection of the many hundreds of millions of dollars that are now invested in our highways, and the enormous amounts that will be invested in additional highways in the future. The motor truck is a valuable and most necessary vehicle, and is an important factor in the East at least to-day in keeping down costs. But the roads are just as important, and really far more so, as without the roads, we would not to-day have the great development of the motor truck which we now have.

That the roads have been abused, there can be no question. Some claim that just as much of the damage is done by heavy loads on horse-drawn vehicles equipped with narrow tires. This is granted in some cases, as the writer has seen some few instances where deep ruts have been cut in a well-built macadam road by just such vehicles. Then some few, and we are glad to say that it is a very few, of the motor truck manufacturers raise the cry that the roads should be built to stand the heaviest motor truck traffic, in which case the roads would not be damaged by a combined truck weight and load of twenty tons. On another page of this issue of Better Roads and Streets will be found an interesting abstract of an address by Nelson P. Lewis, Chief Engineer of the Board of Estimate and Apportionment of New York before the annual meeting of the American Road Builders' Association, in which he shows that the general trend of the manufacturer of motor trucks is for decreasing instead of increasing the capacity of the motor truck. This is taken to clearly show that the reasonable capacity truck and not the extreme is the economical truck to operate.

All who are actively interested in road improvement will realize and appreciate the folly of even attempting to follow the advice of a few of the truck manufacturers "to build the roads for the heaviest loads and the greatest traffic and they will not be damaged," for it is only too well known how difficult it is in many States, and in many counties of these States, to even raise the funds for the improvement of a considerable mileage of roads with even the cheaper types of roads. Were the same roads, totaling a considerable mileage, to be paved with concrete, reinforced concrete, bituminous concrete, Warrenite, Amiesite, asphalt block or brick, the mileage would, on account of the higher cost, be so greatly reduced that it would be a great many years before any kind of a highway system could be completed, as it would be a practical impossibility to raise the necessary funds for the construction of roads of the above mentioned types. We are compelled, therefore, to make the best of it and build in every individual case the best type of road that it is possible to build with the amount of money that is available, and at the same time secure sufficient mileage to simplify transportation in each individual case.

The writer presents herewith some interesting data and material from several of our States on truck legislation and registration, and more will follow in subsequent issues.

### PROVISIONS OF THE BILL.

Section 1.—No traction engine, road engine, steam roller, automobile truck, or other power vehicle, the faces of whose wheels are fitted with spikes, shall be driven upon public highways in this State which have been improved, in whole or in part, with the aid of funds of the State of Michigan, paid in the shape of highway rewards by the State to any road district of the State. No such vehicle whose wheels are fitted with flanges, ribs, clamps, cleats, rings or lugs, or any other projection, shall be permitted to use such highways unless such projections are fastened upon all the wheels thereof, and are not less than two and one-half inches wide and not more than one and one-half inches high, and are so placed that not less than two of the said projections upon each wheel bear upon the ground at all times, and so that the weight shall be distributed equally on all parts thereof. But where such vehicles are used solely in transporting agricultural machinery or products, the following requirements shall apply:

A.—There may be a guide band not less than two inches wide on the front wheels, in which case no flanges, ribs, clamps, cleats, rings, or lugs shall be required.

B.—The full set of flanges, ribs, clamps, cleats, rings, or lugs furnished upon the rear wheels of such vehicles, according to the original design, must be used.

C.—No rivet heads or bolts shall be allowed to project upon either front or rear wheels.

Section 2.—Such vehicles whose equipment does not comply with this Act may be licensed by the State Highway Commissioner to travel upon such highways in cases where coverings of wood or other substances are attached to the wheels in such manner as to present a smooth surface, and in accordance with the regulations fixed by the Commissioner. No vehicle subject to the provisions of this Act shall be equipped with ice picks or mud lugs. No such vehicle which, with its load, weighs over fourteen tons, shall be operated upon any highway of this State subject to the provisions of this Act, unless a license therefor is previously secured from the State Highway Commissioner. Such license shall prescribe such regulations as are necessary in the opinion of the Commissioner for the preservation of the highways. No object which weighs more than fourteen tons shall be moved over such highways by means of wheels, rollers, or otherwise, without a similar license from the State Highway Commissioner. No load exceeding nine tons shall be carried upon any one axle or upon any single roller. Except as herein otherwise provided, the tires of such vehicles shall be smooth and the weight of such vehicles when loaded shall not exceed eight hundred pounds per inch in width of such tires, except in cases where the carriage of a greater weight is permitted by the State Highway Commissioner.

Section 3.—No such vehicle of greater width than ninety inches shall be operated upon any such highway, excepting that traction engines having a width of one hundred and ten inches may be so operated.

Section 4.—No such vehicle weighing when loaded over four tons shall be run upon any such highway at a speed greater than fifteen miles per hour. No such vehicle weighing when loaded more than six tons shall be run on any such highway faster than six miles an hour, if it is equipped with iron

or steel tires, nor faster than twelve miles an hour if it is equipped with tires of hard rubber or similar substance.

Section 5.—In cases where the State Highway Commissioner is authorized by this Act to grant special licenses or permits, he shall do so only upon written application made in such form as he shall prescribe. Such licenses and permits shall be written and shall plainly state the acts which are thereby permitted to be done, and shall be issued under such restrictions as the Commissioner shall prescribe.

Section 6.—The owner, driver, or operator of any vehicle subject to the provisions of this Act, and the owner of any object, other than a vehicle operated on or transported over such highway, shall be responsible for all damages to said highways resulting from the violations of this Act, or from the violation of the terms and provisions of any license or permit granted by the State Highway Commissioner. The amount of such damages may be recovered in an action of trespass on the case by the State Highway Commissioner, or by the Board of County Road Commissioners of the county in which such damage occurs. The amount of such damage shall also be a lien upon the vehicle or object transported which is the cause thereof.

Section 7.—Any person who violates the provisions of this Act, or who exceeds the provisions of any license or permit issued by the State Highway Commissioner under this Act, shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not to exceed two hundred and fifty dollars ($250.00), or shall be imprisoned in the county jail not to exceed six months, or may be both fined and imprisoned at the discretion of the Court.

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In addition to drafting and recommending the above bill, the Wayne County Board of County Commissioners makes the following interesting comment:

"We also recommend that Section 34, Act 302, Public Acts of 1915, be amended so as to include special fees credited to the State Highway Department, consisting of licenses for chauffeurs, manufacturers' and dealers' licenses; duplicate plates lost or destroyed, and motorcycle licenses be included in the distribution to be returned to the treasurer of each county on the basis of fifty per cent. of the amount collected to be used to maintain the highways by the local authorities. During the past year, over thirty thousand dollars ($30,000.00) was collected from this source, the major portion coming from Wayne County, and all of it was credited to the State Highway Department. We feel that it should be treated in the same manner as the amounts collected from registered motor vehicles in each county, and we urge that the proper steps be taken by the County Board of Supervisors to bring this recommendation to the attention of the Wayne County delegation in the State Legislature."

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### RULES PROPOSED IN NEW JERSEY.

The special committee appointed by William L. Dill, Commissioner of Motor Vehicles of the State of New Jersey last May, has just made its report and recommendations of proposed tentative rules and regulations to govern the use of motor vehicles or trucks on the highways of the State of New Jersey. These rules are considered drastic by the motor truck owners and manufacturers, and are subject to final revision before their final adoption. The rules and regulations as drawn by the committee are, however, presented herewith:

1.—No commercial vehicle or truck of over four thousand (4,000) pounds weight shall be more than ninety-six inches in width, outside measurements, except that in extreme cases the Commissioner of Motor Vehicles shall be privileged to issue permits for the operation of motor vehicles or trucks with a width of load over ninety-six inches where the weight of the load is not a factor.

2.—No commercial vehicle or truck shall be equipped with metal tires that may be in contact with the surface of the road, nor shall any such vehicle or truck be equipped with any tires which have a partial contact of the metal with the surface of the road.

3.—No commercial vehicle or truck shall be equipped with any tire covering of metal, or with any lugs of hobs, or other sharp devices which would be in contact with the surface of the road, excepting chains, which may be used in accordance with the Motor Vehicle Act.

4.—The height of all commercial vehicles or trucks shall be limited to twelve feet and two inches.

5.—All commercial vehicles or trucks should be equipped with a sealed governor, the speed to be regulated as per the schedule attached hereto as shown in Table No. 1.

6.—No commercial vehicle or truck shall be equipped with a center searchlight, but the lights of all commercial vehicles or trucks shall be in conformity with Section Four of the Motor Vehicle Act.

7.—The extreme length of motor vehicles or trucks shall not exceed twenty-three feet and six inches.

8.—Not more than one trailer can be allowed to any commercial vehicle or truck. In every case the said trailer shall be equipped with rubber tires.

9.—All commercial vehicles or trucks shall carry a spare wheel, so as to avoid the possibility of any part of the steel rims coming in contact with the surface of the road should the rubber tires become broken or otherwise damaged.

10.—All drivers of commercial vehicles or trucks shall carry way-bills for each load, said way-bills to show the gross weight and the net weight carried.

11.—The commercial sizes of tires used on all commercial vehicles or trucks shall be determined on the maximum width of rubber.

12.—All license fees shall be based on the maximum wheel load carried on the same, said wheel load to be determined by the size of tire used, and adopted in conformity with the schedule attached hereto as shown in Table No. 1.

13.—All trailers or semi-trailers shall be licensed on their carrying capacity.

14.—All counties in the State shall place signs showing the clearance on all bridges in their respective counties if the clear headroom is less than twelve feet and six inches.

15.—A special permit shall be secured from the State Motor Vehicle Commissioner for the use of motor trucks as pleasure vehicles.

16.—The trucks or commercial vehicles equipped with under-sizes tires shall not be licensed.

17.—On each rear wheel, one-third of the gross weight of the truck and its carrying capacity combined must be within the limits of the schedule of the respective diameter of wheel, size of tire, and speed in miles per hour as shown in the schedule attached hereto, as shown in Table No. 1.

18.—The front axle shall carry the balance of the gross weight of the truck and load combined, and must be within the limits of the schedule of the respective diameter of wheel, size of tire, and speed in miles per hour for single tires, as shown by the schedule attached hereto in Table No. 1.

19.—All commercial vehicles or trucks carrying any load extending beyond the sides or ends of the outside dimensions of said vehicles or trucks shall have displayed at the outside extremity of such load a red flag which shall be not less than twelve inches square, and which shall be so long as to present a full view to approaching vehicles.

TABLE NO. 1.

| Tire Size Inches | Wheel Diameter Inches | Maximum Wheel Load in Pounds | | | | | | Speed in Miles per hour |
|---|---|---|---|---|---|---|---|---|
| | | 32 | 34 | 36 | 38 | 40 | 42 | |
| 2 | Single .... | 565 | 595 | 625 | 660 | 690 | 720 | 20 |
| 2½ | Single .... | 840 | 890 | 940 | 990 | 1,040 | 1,090 | 20 |
| 3 | Single .... | 1,125 | 1,190 | 1,250 | 1,315 | 1,375 | 1,440 | 20 |
| 3½ | Single .... | 1,415 | 1,490 | 1,565 | 1,640 | 1,715 | 1,790 | 18 |
| 4 | Single .... | 1,690 | 1,780 | 1,875 | 1,970 | 2,065 | 2,155 | 16 |
| 5 | Single .... | 2,250 | 2,375 | 2,500 | 2,625 | 2,750 | 2,875 | 14 |
| 6 | Single .... | 2,815 | 2,970 | 3,125 | 3,285 | 3,440 | 3,595 | 12 |
| 7 | Single .... | 3,375 | 3,565 | 3,750 | 3,940 | 4,125 | 4,315 | 10 |
| 2 | Double ... | 1,125 | 1,188 | 1,250 | 1,312 | 1,375 | 1,438 | 18 |
| 2½ | Double ... | 1,675 | 1,775 | 1,875 | 1,975 | 2,075 | 2,175 | 18 |
| 3 | Double ... | 2,250 | 2,375 | 2,500 | 2,625 | 2,750 | 2,875 | 16 |
| 3½ | Double ... | 2,825 | 2,975 | 3,125 | 3,275 | 3,425 | 3,575 | 14 |
| 4 | Double ... | 3,375 | 3,560 | 3,750 | 3,940 | 4,125 | 4,310 | 13 |
| 5 | Double ... | 4,500 | 4,750 | 5,000 | 5,250 | 5,500 | 5,750 | 12 |
| 6 | Double ... | 5,625 | 5,940 | 6,250 | 6,565 | 6,875 | 7,190 | 10 |
| 7 | Double ... | 6,750 | 7,125 | 7,500 | 7,875 | 8,250 | 8,625 | 10 |

TABLE NO. 2.

*Schedule Showing Annual License Fee, and Fee After September 1, Based on Gross Weight.*

| *Gross Weight of Truck and Carrying Capacity in Pounds* | *Annual Fee* | *Fee After September First* |
|---|---|---|
| 4,000 or less | $15.00 | $7.50 |
| 4,000 to 5,000 | 17.50 | 8.75 |
| 5,000 to 6,000 | 20.00 | 10.00 |
| 6,000 to 7,000 | 22.50 | 11.25 |
| 7,000 to 8,000 | 25.00 | 12.50 |
| 8,000 to 9,000 | 27.50 | 13.75 |
| 9,000 to 10,000 | 30.00 | 15.00 |
| 10,000 to 11,000 | 32.50 | 16.25 |
| 11,000 to 12,000 | 35.00 | 17.50 |
| 12,000 to 13,000 | 40.00 | 20.00 |
| 13,000 to 14,000 | 45.00 | 22.50 |
| 14,000 to 15,000 | 50.00 | 25.00 |
| 15,000 to 16,000 | 55.00 | 27.50 |
| 16,000 to 17,000 | 60.00 | 30.00 |
| 17,000 to 18,000 | 65.00 | 32.50 |
| 18,000 to 19,000 | 70.00 | 35.00 |
| 19,000 to 20,000 | 75.00 | 37.50 |
| 20,000 to 21,000 | 81.25 | 40.63 |
| 21,000 to 22,000 | 87.50 | 43.75 |
| 22,000 to 23,000 | 93.75 | 46.88 |
| 23,000 to 24,000 | 100.00 | 50.00 |
| 24,000 to 25,000 | 106.25 | 53.13 |
| 25,000 to 26,000 | 112.50 | 56.25 |
| 26,000 to 27,000 | 118.75 | 59.38 |
| 27,000 | 125.00 | 62.50 |

The committee which prepared and submitted the above report for New Jersey consisted of Thomas J. Wasser, Chairman; John J. Albertson, Garwood Ferguson and Alvin Fox, and Frederic A. Reimer, County Engineer of Essex County, N. J., secretary.

Regarding the proposed New Jersey regulations, motor truck owners set forth the claim that it will be commercially impossible to operate any kind of motor truck in the State of New Jersey if the recommendations of the special committee appointed by William L. Dill, Commissioner of Motor Vehicles, are enacted into law. The Motor Truck Club of America, New York City, has taken the question up at several meetings, the last of which was on November 15, when Commissioner Duffey, of the New York Commission of Highways, and chairman of a special committee to draw up new motor vehicle laws for his State, was present and addressed the club on the subject. A summary of what occurred at that meeting will be found at the conclusion of this article.

Taken up paragraph by paragraph, the views and opinions of the owners and of the manufacturers of motor trucks are given herewith, as relating to the proposed legislation in New Jersey. The numbers preceding the comment refer to the paragraphs of the same numbers of the rules and regulations as proposed in that State.

1.—There is no serious objection provided the permits referred to therein be for one year and be granted to users of trucks in certain trades where the nature of the commodity to be transported is such as to require wider trucks.

2.—The general substance of paragraph two relating to the use of steel tires on trucks is not objected to, provided an exception is made in those rare classes of trucks where the speed is low. This will permit the use of such trucks produced by one of the manufacturers of commercial vehicles, and described in the following extract from a letter from this manufacturer:

"We have built, and have in service, a number of trucks where the drive is by the front wheels; the rear wheels being equipped with larger diameter, wide steel tires. It stands to reason that if the wheel is sufficiently large in diameter, and the tire sufficiently wide, and weight per inch of width within a certain limit, that the road will not be damaged."

Furthermore, the speed of this type of truck is low, namely, about five miles per hour.

3.—The general purpose of this paragraph relative to tire coverings was approved, excepting that the phraseology should be so changed as to permit other and improved devices of such a character as would do no more harm to the roads than that done by chains. Such devices to be used in accordance with the Motor Vehicle Act.

4.—No serious objection was made about the height of trucks, provided that special permits could be obtained in those cases where the nature of the load required a greater height.

5.—Considerable objection was made to this paragraph on governors, the ground being that sealed governors have never proven successful in operation, and that drivers are able to so manipulate them as to make them actually worthless. The objection was also made that they readily get out of order, and that in order to be effective so many parts of the truck must be inclosed that it would be impossible to make needed repairs on the road without breaking the seals. It was also pointed out that the safety of pedestrians would be in danger by the arbitrary limitation of speed, as the driver is, in many instances, able to avoid an accident by a burst of speed. It was also pointed out that many trucks now in use are so constructed that a governor could not be installed. Attention was also called to the fact that governors cannot be placed on electric trucks, and that a governor on an electric truck would be unnecessary even if it could be installed. The point was also brought out that if the speed of the truck is to be limited, the speed limit of the truck loaded should be different from the limit imposed while the truck is running light.

6.—Regarding prohibiting the use of a center searchlight as provided in this paragraph, no serious objection was offered, although it was suggested that provided the usual lights are carried, the additional center searchlight would do no harm.

7.—In regard to the proposed restricted length of twenty-three feet and six inches, it was the consensus of opinion that the maximum length should be twenty-eight feet instead of the limit as proposed, and that it should be made clear that this regulation does not apply to semi-trailers and trailers.

It was also pointed out that in many instances the extreme length of a horse-drawn wagon from the tip of the horses' noses to the rear edge of the tailgate is in excess of the limit which it is sought to place on the motor truck.

8.—The proposal that not more than one trailer should be allowed to any commercial vehicle or truck was not seriously objected to, provided special permits were granted to use more than one trailer under conditions where it would not be dangerous to pedestrians or injurious to the road. It was pointed out that it might be safe to operate a train of trailers at night when the roads were not congested. The recommendation that trailers should be equipped with rubber tires was objected to, and it was suggested that in order to protect the roads a limitation be made, based on the inch width of steel tires, and perhaps a limitation of speed.

It was also pointed out that in the case of semi- or two-wheeled trailers, these are many times horse-wagons with the front wheels removed, and in some cases hauled alternately by tractors and teams. They carry no greater load when hauled by a tractor than by horses, so it could not be seen why they should be shod with rubber tires in one case when the steel tires suffice in the other.

It was stated in connection with this paragraph that the members of the Special Committee apparently were not aware of the fact that a string of trailers can be so handled as to require no more room to negotiate a corner than does the conventional motor truck, or in other words that the trailer wheels can be made to track with the truck or tractor wheels. It was also suggested that the members of the Special Committee be invited to a demonstration showing that this can readily be done.

9.—In regard to the recommendation that each truck carry a spare wheel to be put on along the road in case any of the rubber tires become broken or otherwise damaged, it was stated that it would be highly amusing to have the Special Committee state how the driver of a five-ton truck, with his helper, could replace one of the vehicle's rear wheels, weighing about eight hundred pounds each, without the aid of a derrick or crane.

10.—The truck owners declare that one of the most absurd provisions of the proposed new law is this one, whereby the truck driver must carry waybills for each load, these waybills to show the gross weight and net weight carried. The utter impossibility of operating a motor truck if the driver must obtain a waybill showing the weight of each load can be realized if one will consider the case of any kind of truck en-

gaged in work in which part of the load must be picked up at different points and delivered at still other points. Every merchant who wanted to ship a parcel or any kind of goods would have to install scales to comply with the proposed measure. Even if this were done at a tremendous expense, the waybills would be of no value as soon as the truck delivered a portion of its load at its first stop. The truck driver would have to be a skilled mathematician to calculate the weight of the goods delivered at the various points, subtracting those from the total load at the start and then adding to what was left the weight of the goods picked up enroute. The drivers would be spending most of their time figuring weights, with very little time left for the actual running of the truck, which, after all, is the only time when it is making any money for its owner.

11.—No objection was made to this paragraph.

12.—Regarding the basis on which license fees are to be determined, it was the general opinion that whatever fee is collected should be a mere license or registration fee, and as such, should not be greater than enough to pay for the registry and expense in connection therewith. In this connection, however, it was pointed out that the proposed rates that if any law is to be passed in the nature of a tax, it should be made to apply to horse-drawn vehicles and others using the roads as well as to motor trucks. It was also pointed out that the proposed rates as suggested by the Special Committee would increase the truck registration fees from the present maximum of $25.00 to a new high mark of $125.00.

13.—In regard to licensing trailers on the basis of their carrying capacity, the decision was reached that practically the same objection exists as exists in paragraph twelve, and that some provision should be made for those trailers carrying different bodies at different times.

14.—No objections were raised to the provisions of this paragraph.

15.—No objections were raised to the provisions of this paragraph.

16.—No objections were raised to the provisions of this paragraph.

17.—Instead of the complicated schedule of tire loads, etc., as stipulated in this paragraph, it is suggested that the result aimed at should be obtained by limiting the load to one thousand pounds per inch of width of tire.

18.—The recommendation for paragraph seventeen covers this paragraph also.

19.—This is accepted without further question than that it be made to include the use of a red lantern in place of the red flag when the truck is driven after dark.

An interesting and most important meeting of the Motor Truck Club of America was held on Wednesday evening, November 15, at the Automobile Club of America, New York City. This meeting was given over entirely to the discussion of motor trucks in their relation to streets and roads, the damage done by the truck to the latter and to the proposed legislation to be passed by New York State and New Jersey regulating and licensing the motor truck.

More than ordinary importance is attached to this meeting for several reasons. In the first place, it is well known that in every section of the country our country highways particularly, and in some places even our highest type city streets are being pulled to pieces and broken up through the enormous increase in the use of the motor truck, and the much heavier loads which it is carrying at constantly increasing speed over our highways and streets. In the second place, other States, realizing that something will have to be done to regulate the use of the motor truck on the roads, are going to pass laws governing such use, and these States are merely sitting back to see what laws are finally passed in New York and New Jersey.

The attendance at the meeting was large, as two important talks had been widely announced, one of these by Edwin Duffey, State Commissioner of Highways of New York State and chairman of the special commission appointed to draft new license and registration fees, rules and regulations for the State of New York, and another by Arthur H. Blanchard, Consulting Engineer of the National Highways Association and to the Board of Water Supply of the city of New York.

Prior to Professor Blanchard's talk, the Chair announced that the first public hearing of the New York Commission would be held at the State Capitol at Albany, on Tuesday, November 21, which is, however, too late to get in this issue of Better Roads and Streets. An account of this hearing, together with a subsequent one to be held in New York City, will be published in the January issue, however.

Professor Blanchard delivered an excellent and greatly appreciated talk on "Road Building for Motor Trucks," during the course of which he showed a large number of fine slides. A synopsis of this talk follows:

More attention should be paid to the factors that are important in the construction of highways that it is expected will be used by large numbers of motor trucks. The truck has come to stay and its use will steadily increase. Equal attention should be paid to horse-drawn vehicles which use the highways. One reason for this was shown by an excellent slide of a granite block street in Brooklyn in which was cut a deep groove caused by horse-drawn vehicles with gauge wider than car tracks using one rail for the wheel while the other, which was the one on the curb side, wearing the granite block through tracking. He then showed numerous slides of the traction engine equipped with lugs drawing trains of six heavy trailers equipped with steel tires, an outfit which soon destroys the average road of to-day. Professor Blanchard stated that he does not believe we have the right to insist upon the elimination of the steel tire, although its use can readily be abused. This abuse should, however, be eliminated. He explained that in England many counties have adopted laws which compel the companies operating on well-designed and well-constructed highways to stand and make good any unusual damage which they may inflict upon the highways. This procedure applies principally to motor omnibuses.

Slides showing the tentative truck highways as proposed by the National Highways Association—roads that start somewhere and lead somewhere—were shown net working the entire country. Sectional State systems as proposed by this Association were also shown, and it was brought out with particular force that the members of the Motor Truck Club of America should use all their influence and power to see that properly designated trunk highways are worked out and then adopted.

A high tribute was paid to William H. Connell, Chief of the Bureau of Highways of the City of Philadelphia by Professor Blanchard, when he stated that the method of organization and the system as worked out in Philadelphia is a model and an ideal one and not surpassed by any city in the United States. It was shown that, although Chief Connell went into office in Philadelphia under a reform administration which has in the past year been succeeded by the old machine control, the new administration was not permitted to oust him. This condition arose through the excellent organization that Mr. Connell has worked out and the excellent work that he has shown in four years can be accomplished under proper working conditions.

If we are to have highways that are to carry and stand up under the increasing motor truck traffic, more attention must be paid to the principles of drainage and foundation and adequate time must be given the engineers to investigate conditions on the proposed improvement and to prepare carefully considered plans.

In taking up the question of foundations, two types are to be given the preference, namely, broken stone and concrete. The latter, of course, is the better, as it is much stronger, and the recommendation has been made in New York State that a concrete foundation be laid under all country highway pavements, regardless of type, on all trunk routes. If this is carried out, it was stated, that will be something to show at the end of fifty years, which is the life of the bonds, as even if the wearing surface does wear out several times, the foundation remains good and is economical in the long run.

Pavements built to-day are generally too narrow. Nothing less than twenty feet wide, whatever the type, should be laid on trunk highways, and we are, in the East, rapidly coming down to this minimum width. Trunk highways in England and on the Continent are even wider, as was shown by several slides. More attention should also be paid to the construction and design of curves, and to grades.

The various types of pavement and the forms of construction were then taken up and described. Of bituminous pavements for country road construction, there are two general types, bituminous macadam and bituminous concrete. The first is the penetration method, but it should be seen that the

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# Problems and Methods in Snow Removal and Disposal*

By H. S. Richards, Superintendent of Maintenance and Repair, South Park Commissioners, Chicago, Illinois

ONE of the most exacting duties of a park official is that of maintaining walks and drives in good condition for travel at all times, even during or shortly after the severe snowstorms of winter. In a park and boulevard system like that of the South Parks in Chicago which has boulevards leading through the crowded downtown business districts, where the traffic at certain hours is exceedingly dense, as well as through the residence districts in which travel is rapidly increasing year by year, problems are met with that are sometimes quite difficult of solution. In this paper I will deal with those concerning snow removal and disposal as they are handled by the South Park Commissioners, Chicago.

The operations connected with this line of work may be outlined as follows:

1. The necessity for an immediate opening of paths through the snow on the walks and drives and this for several reasons—

(a) to facilitate traffic;

(b) to prevent packing the snow which would result in an increased cost for removal;

(c) to protect the pavements from the wear occasioned by traffic, which usually follows the ruts worn in packed snow;

(d) to prevent the possible formation of a dangerous icy coating by alternate thawing and freezing.

2. The actual removal or disposal as soon as possible after paths have been opened, of all snow from walks and drives in the busy downtown sections by hauling to the dump or otherwise.

As to the methods of handling the snow-cleaning problems, the first means used for cleaning the walks and opening paths on the drives was that of horse-drawn plows. On all the walks, except those in front of business houses in the downtown district, who clean the snow off their walks and deposit it in the streets, both one and two-horse plows are used—the V-shaped plow for one horse and small road graders for teams. These types have answered the purpose fairly well as they are easily handled.

Snow removal from the drives has proved a more difficult problem, as some traffic is constantly passing along packing the snow even while it is falling. The type of horse-drawn plow that has given most satisfactory service has been the four-wheeled adjustable-blade road grader. Hitches of from two to four horses, depending on the depth of snowfall and its character, as to whether it was dry and light or wet and heavy, have been used on a machine. On most of the boulevards and in the larger parks these plows are used in groups of four to six, all travelling in the same direction and lined up diagonally in such a way as to clean the entire drive in one round trip. The first plow throws the snow from the center of the drive toward the gutter, each succeeding plow cleaning its swath and throwing the ridge of snow closer to the gutter until the last plow has piled it up along the curb. In going in one direction one-half of the driveway is cleaned and on the return trip the other half. Some of the boulevards have two drives, one on each side of a central strip of lawn. On these the snow is all cleaned towards the central parkway so as not to pile it up in front of the homes on either side of the boulevard.

In the South Park system there are at present forty-five miles of drive from which snow is cleaned in winter. To cover these drives with horse-drawn plows in a reasonable time would require a larger equipment of horses and plows than that now on hand—in fact several times as large—as the horses cannot travel faster than a walk through the snow and although heavy draft horses have always been used, the work with a moderate snowfall is quite wearing on them. While horse-drawn plows are covering their routes some snow is being densely compacted by the constantly passing traffic, with the result that these plows remove little more than the loose snow, being practically unable to rip the packed snow off the pavements, to which it adheres very firmly. Ruts are formed in the packed snow and traffic following these ruts wears down through the snow to the pavement. As automobile tires in winter are usually equipped with chains the resulting wear of such traffic on the narrow strips of pavement at the bottoms of the ruts damages the pavement considerably, necessitating costly repairs in spring.

As soon as motor trucks became practical vehicles we tried various snow plow attachments on them, but have never found one that will clean snow as desired. Quite a little time and money was spent in fitting up a five-ton truck for snow cleaning work, but it did not give satisfactory service. One of the chief difficulties for a long time was the lack of traction when moving ridges of snow from the centers to the sides of the drives, even after a moderate fall of snow. As soon as the ridges acquired any depth to speak of the motor plows became helpless through lack of traction, not that the motors were not powerful enough but because the trucks became "stalled" and slid sideways with the rear wheels revolving on the pavement.

In the winter of 1914-1915 a new type of snow-cleaning machine came to my notice. This outfit consisted of a three-wheeled gasoline tractor fitted in front with a V-shaped plow or mold-board which was removable, and a large revolving street broom mounted on wheels to be attached behind the tractor. The construction of the outfit was quite heavy so as to withstand the strain of plowing through banks of heavy wet snow. The plow blade has considerable curve, which causes it to travel quite close to the pavement when plowing, and on one side of the plow there is an adjustable extension or wing, which can be set at any desired angle as conditions require.

Demonstrations were given which showed the ability of the outfit to operate satisfactorily under the different conditions of snowfall usually met with, and the result was that the Park Commissioners ordered three of the outfits for service in the winter of 1915-1916. As the need for snow cleaning is felt most in the congested downtown district, which is also the most difficult district to clean, the three tractor plows were assigned principally to that district. After various preliminary trials it was learned that the broom attachments were the best for cleaning walks and for very light snow on the drives, while for the heavier snows the tractors gave better service with the plow attachments. It was finally decided that the best plan for this district was to fight the snow while it was falling and not permit it to accumulate at all nor give it any chance to become compacted by traffic.

So it was arranged that two of the tractors with brooms and the third with plow as well as revolving broom should be put into operation shortly after a snowfall began and continue operating as long as snow was falling. The third tractor was equipped with a plow in addition to a broom because it had to move the ridge of snow swept aside by the two tractors immediately preceding it. The snow was cleaned from the center to the sides of the drive, the machines travelling with the traffic at a rate up to ten miles per hour, so that they made a round trip over a particularly busy stretch of downtown boulevard a little over a mile in length every fifteen or twenty minutes. The snow is continually being brushed towards the sides of the drive ready for hauling to the dump, so that practically as soon as the snowfall ceases the machines are through with this stretch of downtown driveway and it is in good condition.

When the machines finish work on the above mentioned drive the revolving brooms are removed, the tractors hook on the plow attachments and are then sent out to assist the horse-drawn plows in cleaning the balance of the park and boulevard drives, the tractors being given the preference for the busy boulevards as their rate of travel is much greater than that of the horse-plows, making them less inconvenient to the travelling public. By changing shifts of drivers the tractors can be operated twenty-four hours per day; this makes them of special value for work during the night when we do not have horse-drawn plows in operation and when the traffic is not so heavy as in the daytime. Although the road graders could also be operated all day and all night with changes of horses and drivers, that plan is not so practical on account of our inability

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*Prepared for the Annual Meeting of the American Society of Municipal Improvements, Newark, N. J., October 10-13, 1916.

# Abstract of the Prescribed Rules of the Office of Public Roads and Rural Engineering for Road Construction under Federal Aid Appropriation

IT will be remembered by the readers of BETTER ROADS AND STREETS that several months ago we published an account of the meeting called by Logan Waller Page, Director of the Office of Public Roads and Rural Engineering, and held at Washington, D. C., which was attended by the State Highway Commissioners and their engineers, representing a large majority of the States, at which meeting the question of the distribution of the money under the Federal Aid Act was thoroughly discussed, paragraph by paragraph. At that time, it was promised that in the near future the final draft of rules and regulations which would govern the construction of roads on which Federal Aid was used, would be published.

Inasmuch as there will be a total of $75,000,000 expended by the Federal Government in aiding the various States in highway construction, the distribution of the money and the rules and regulations governing its expenditure are naturally of the greatest importance. The writer has found, however, in talking with large numbers of persons interested in highway improvement, that there is a very hazy conception regarding the methods of handling this money and the rules that will govern the distribution and payments, excepting among the State Highway Departments, practically all of whom have carefully studied it out.

As a result of the meeting of State Highway Officials above referred to in Washington, a complete set of rules and regulations was formulated and issued by the Office of Public Roads and Rural Engineering. These rules and regulations are so classified that they set forth the Government's contact with each individual step of the procedure and the project. They also give assurance that close supervision will be provided and assured from the first steps, the proposal of a project, until its final completion. In other words, the Government, through the Office of Public Roads and Rural Engineering, Department of Agriculture, will know at all times just how the money is being spent and what it is being spent for.

The rules and regulations as issued are lengthy and in detail. Owing to the lack of space in BETTER ROADS AND STREETS, they have been abstracted and this abstract, which contains briefly all important features, is presented herewith:

### INFORMATION FOR THE SECRETARY.

Before an agreement is made upon any road or roads to be constructed in a State, or the character and method of construction is decided upon by the State highway officials, upon request of the Secretary of Agriculture there shall be furnished to him, by or on behalf of the State, general information as to its laws affecting the construction of roads, and the authority of the State and local officials in reference to the construction and maintenance of highways; as to schemes and plans in mind for future construction; and as to provisions made or to be made for constructing and maintaining the roads upon which it is contemplated that the expenditure of money appropriated by or under the Federal Aid Act will be proposed.

The information to be furnished shall be sufficient to enable the Secretary of Agriculture to determine whether it is likely that the money appropriated to the State will be expended, that the roads after they are constructed, will be properly maintained, in strict accordance with the terms and intent of the Federal Aid Act.

### PROJECT STATEMENTS.

A project statement shall contain all information necessary to enable the Secretary of Agriculture to ascertain and determine the following points:

1. Whether the project conforms to the requirements of the Federal Aid Act.
2. Whether adequate funds, or their equivalent, are or will be available by or on behalf of the State for construction.
3. What purpose the project will serve and how it correlates with the other highway work of the State, both completed and contemplated.
4. The administrative control of and the responsibility for the project.
5. The practicability and the economy of the project from an engineering and from a construction standpoint.
6. The adequacy of the plans and the provisions that have been and will be made for the proper maintenance of the roads after they have been constructed.
7. The approximate amount of Federal Aid that is desired by the State.

With each statement there shall be submitted for the approval of the Secretary of Agriculture copies of the form of contract, together with all documents referred to therein or made part thereof, and of the contractor's bond which it is proposed to use on the project.

Projects will be deemed preferred, and recommended for approval, by the State Highway Department in the order in which the project statements are submitted, unless it should be otherwise specified in writing. The secretary of Agriculture may, however, at his discretion, consider the projects in a different order.

Each project statement shall be accompanied by a sketch map showing the location of the proposed project, together with all main contiguous transportation features.

Suitable samples of materials suggested for use in the construction of each particular project will be submitted to the Office of Public Roads and Rural Engineering whenever a request for such materials shall be made by the Office of Public Roads and Rural Engineering.

Where any part of the cost of any project is to be furnished by a county or other local sub-division or sub-divisions of a State, the project statement shall be accompanied by a certified copy of each resolution or order, if any, of the appropriate local officials respecting the funds which are or will be made available, or respecting the supervision of the construction of the road and of the expenditure of the money provided or to be provided for paying for the cost of such work.

### SURVEYS, PLANS, SPECIFICATIONS AND ESTIMATES.

Surveys and plans shall show all necessary data in connection with the specifications and estimates, to enable the Secretary of Agriculture to ascertain and to pass upon location, grades, drainage, bridges and other structures, and special and unusual features, the work that is to be performed and the probable cost thereof.

Specifications shall set forth the proposed method of construction, the type of construction, the materials to be used, and all other essentials, together with all such details as will afford complete knowledge of all steps to be taken in the construction of the project.

The estimate for each project shall show the estimated quantity and cost of each item of construction in detail, and shall also show separately the ten per cent. fund, and shall not include any expenses of advertising the project.

### RIGHTS-OF-WAY AND GRADE CROSSINGS.

Rights-of-way necessary for any project shall be provided, and any incidental damages to adjoining property due to construction work paid, by or on behalf of the State, and the expense thereof shall not be included in the estimate or paid in any part by the Federal Government.

Grade crossings shall be avoided where practicable. The estimated cost of eliminating a grade crossing shall not include any amount the State, county, or other civil sub-division is entitled to receive, as reimbursement or payment from the owner of a public utility or a public service corporation, on account of such elimination work.

No part of the expense of making surveys, plans, specifications or estimates by the State prior to the beginning of construction shall be included in the estimate or paid by the Federal Government.

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# Wood Block Pavements with Reference to Economic and Efficient Wood Preservatives*

By J. W. Howard, Consulting Engineer on Pavements, 1 Broadway, New York City

EXPERIENCE is the best teacher. Records of European and American cities of fifty years and the experience of living engineers during the past thirty years, show what wood pavements have and have not given economic and efficient results. New and relatively untried wood preservative oils or compounds should not be tried at public expense nor adopted for use until proven to be good. A specification should be a standard of enumerated qualities which all materials, good for the purpose, must meet; and not be a description in technical language of one special brand or product, to the exclusion of others, known by experience to be good, efficient, durable, and economic.

Many engineers have seen specifications which are practically a secret description in technical and chemical language of one brand or product of paving material, without naming it or revealing the selfish interest controlling and promoting it. We have seen the omission of necessary tests and insertion of some special specific gravity, and limited distillation tests of preservative for wood paving blocks with numerical requirements, such that practically only one brand or group of tar-products could meet these peculiarities, several of the included requirements having nothing to do with the needed qualities of the oil. Such specifications may be a basis for promotion and political money influence, but are not a good basis for economic pavements and taxation.

Specifications originating from commercial or selfish interests must be carefully investigated. Many honest and informed city engineers have saved their cities from excessive prices for pavements by insisting on specifications being open to competition from equally good and often superior wood preservatives, likewise for other paving materials. Unfortunately, in some cities controlled by a political boss and venal public officials, it has not always been possible for a city engineer to prevent the use of an objectionable specification. This does not apply to a patent material or article when the patent is previously made known, the material especially good for the location, the known price reasonable and just, and the city and all contractors can obtain the patented material at the same price.

It is the well recognized duty and policy of the American Society of Municipal Improvements to adopt specifications which shall be standards of excellence, expressed in the specification by physical and chemical requirements and tests, which fully show that the material, whether it be wood preservative or other, is good for the use intended; and such specifications must omit all chemical or other requirements which have nothing to do with quality, but which are descriptions and limit the material to one brand, or product, to the exclusion of equally good or better.

Many of us engineers know a specification descriptive of a tar product or tar-oil compound for wood pavement blocks, which has appeared in some important cities and been before this and other societies, which specification is a description, inserted as tests, put there to control or limit the special "tar product" to be used, to a pitch or tar containing oil, which practically excludes competition and prevents the use of good, long established, standard distillate creosote oils. This exclusion is accomplished by specifying a heavy specific gravity of 1.08 or heavier, combined with the requirement that the total distillates up to 315° C. shall not be more than 50% (or even 40%) and not forbid stiff, brittle residues; whereas some pure, good creosote oils yield as high as 85% total distillates up to 315° C. and some 95% up to 355° C. and have specific gravities both below and above 1.08, and have good, soft residues; as per tests of good types of excellent creosote oils of America and Europe given later in this paper and in reliable books of authority. Such specifications should be changed accordingly, so as to secure competition from more creosoting plants and paving contractors, and to obtain cheaper prices, better and more efficient wood pavements; all other requirements for the pavement foundation and construction being equal and good.

The set of tests for wood preservatives should be as few and as simple as possible, so as to be made in any good laboratory and easily understood by city engineers who are not chemists. All preservatives for wood paving blocks (and there are several good ones) should be insoluble in water; be able to thoroughly impregnate the wood and thereby practically exclude water. The exclusion of water is to prevent swelling of the blocks and buckling of the pavement; also to prevent fungus or germ growth which cannot exist without water in the blocks. Preservatives should have germicidal or antiseptic qualities. They should be stable and not have their essential qualities evaporate and leave the wood from the effect of the sun, air, or other elements. They should not ooze or bleed out of the wood to any noticeable amount either from the heat of the sun or from the compression of the blocks, to a material loss of the preservative, or to thereby make a pitchy, dirty pavement, injurious to pedestrians, vehicles, floors, and carpets or adjacent buildings, as occurs with tar products not creosote oils.

Beyond giving several types it is unnecessary for me to go into the details of the several good wood preservatives and the laboratory tests of them, because their descriptions and tests are found in old, standard, open specifications of many cities, and in chemical and engineering publications of the United States, Germany, England, and France, easily obtainable in all large libraries.

Because of their comparative cheapness and abundance all over the world, by-product coal and gas-tars are the sources from which most good distillate creosote oils are manufactured for this purpose. Within a few years water-gas-tars have become the basis of manufacture of wood preserving oils which, alone or combined with coal-tar distillate creosote oil, give promise of successful economic results in wood preservation as laid under W. H. Connell, C. E., in 1912 on Arch Street, Philadelphia. The Bethell process of wood preservation devised in 1838 for impregnating wood with tar distillate creosote, and many modifications and substitutions thereof, such as Labrot, Lowry, Card, Burnett, and Rueping, have all been used for many years with success.

Creosote oils compose the group of the principal preservatives for wood; the best being always made by distilling tars and are not tar products or compounds of oils and pitch which are not distillates and are objectionable. U. S. Forestry Service Circular 206, page 9, shows that creosote oils are all distillates manufactured from many tars, stating it briefly in the following words: "The general process of manufacture is similar in all cases. The tar is distilled in a metal retort or still and the vapors are condensed and collected. Those distillates which are heavier than water form the true creosotes used in wood preservation. The temperatures at which the creosotes are obtained vary greatly, but generally lie between about 200° and 360° C. The actual temperatures in each case depend largely upon the character of the residue desired."

The *best creosote oils* are, therefore, all *distillates*. *A good and efficient specification admitting all good and excluding all poor creosote oils for wood paving blocks should require as follows*: The preservative used must be a distillate creosote oil of above 1.03 sp. grav. at 38° C. (100° F.), containing less than 1% of matter insoluble in benzol by hot extraction. It shall be waterproof, antiseptic, containing at least 10% of crystallizable napthalene, and at least 15% of the stable anthracene oil. When distilled as described in Bulletin No. 65, American Railway Engineering and Maintenance-of-Way Association, the total distillate on basis of water-free oil up to 150° C. (302° F.), shall not exceed 1%; the total up to 200° C. (392° F.) shall not exceed 5%. The distillation shall be continued to 315° C. (600° F.), and the residue then remaining, when cooled to 25° C. (77° F.), shall be soft and easily indented with the finger. The creosote oil used shall be a distillate made from coal-tar or a combination of distillates from

*Prepared for the Annual Convention of the American Society of Municipal Improvements.

coal-tar and water-gas-tar; provided the oil produced meets all the above tests of qualities needed for thoroughly preserving wood. All such creosote oils contain enough napthalene to be germicidal and prevent decay of wood. They also contain a large amount of anthracene oil which is waterproof, stable and cannot be volatilized or injured by the elements and being heavier than water is not floated out of wood but remains, excluding water which is the vital enemy of structural wood.

The high grades of true, distillate (pitch free) creosote oils, used in the minimum quantity needed, even as low as fourteen pounds per cubic foot of wood, and thoroughly impregnating it, do not ooze from the wood blocks, as do the impure compound oils containing any appreciable amount of pitch (the stiff, hard part of crude tars); even when such compound oils are used in as small quantities. The pitch-containing oils do not generally thoroughly impregnate the wood and often contain other impurities affected by water and the elements in hot, cold, or wet weather.

The citizens want clean, handsome street pavements from the beginning. We must not permit dirty, pitchy, tarry pavements, when it is possible, as shown by long experience in all countries, to construct wood pavements which are and remain clean from the start. Imagine any person trying to persuade Paris, Berlin, or London to replace their clean, good wood pavements, with a kind which would be covered with oozing, bleeding tar in warm weather, or to persuade Boston to do so on the part of Tremont Street, where a clean wood pavement has been in use for more than twelve years, or Baltimore to substitute the tarry kind for its long used, clean wood pavements, still in good condition. The continued success I have personally observed during the past thirty years, of clean, good, durable wood block pavements, in Berlin, Paris, London, Tremont Street, Boston, lower Broadway, New York, certain streets in Baltimore, Chicago, St. Louis, South Bend, Toledo, and elsewhere, have long since convinced me and many others that there is no need of abandoning that which is good for that which is tarry, and to say the least not more durable.

A specification for wood block pavement should be such as to enable a city to have durable wood pavements where needed and to assure competition and lowest possible cost; and to use any kind of wood block pavement which had already shown itself successful in any city. No specifications should exclude wood pavements which have proven themselves to be durable, efficient, successful and in good condition in actual use for a period of ten or more years, under severe climatic conditions and heavy, numerous traffic. The above safe, open, single, comprehensive specification is the best and would permit competition and the use of every one of the good distillate creosote oils which have been successful. Such genuine distillate creosote oils of commerce are obtainable from many competing sources in America and Europe, and can be easily manufactured from all tars in small plants by any one desiring to do so. The best creosote oils are not controlled through patented processes nor through by-products of patented processes of coke or gas manufacture, nor by any trust or business combination.

One of the best descriptions and requirements for good creosote oil is that adopted by the American Railway Engineering Association as recommended by committee XVII. on wood preservation, composed of Messrs. Stimson, Bowser, von Schrenk, and nine other members, as follows:

"*Grade 1 Coal Tar Creosote*, referred to also as Maintenance-of-Way-Oil No. 1. The oil used shall be the best obtainable grade of coal-tar creosote; that is, it shall be a pure product obtained from coal gas tar or coke oven tar and shall be free from any tar, including coal gas tar and coke oven tar, oil or residue obtained from petroleum or any other source; it shall be completely liquid at thirty-eight (38) degrees centigrade and shall be free from suspended matter; the specific gravity of the oil at thirty-eight (38) degrees centigrade shall be at least 1.03. When distilled by the common method—that is, using an eight (8) ounce retort, asbestos covered, with standard thermometer, bulb one-half (½) inch above the surface of the oil—the creosote, calculated on the basis of the dry oil shall give no distillate below two hundred (200) degrees centigrade, not more than five (5) per cent. below two hundred and ten (210) degrees centigrade, not more than twenty-five (25) per cent. below two hundred and thirty-five (235) degrees centigrade, and the residue above three hundred and fifty-five (355) degrees centigrade, if it exceeds five (5) per cent. in quantity, shall be soft. The oil shall not contain more than three (3) per cent. water."

The committee, Proceedings Vol. 15, page 632, further stated: "Whenever possible only Grade 1 Coal Tar Creosote should be used, and under no circumstances should coal tar be added to creosote of this grade."

In Appendix A, by Dr. H. von Schrenk and A. L. Kammerer, page 680, they state: "The writers firmly believe that the best results with creosoting will always be obtained by the use of oil equivalent to the American Railway Engineering Association No. 1 oil. * * * The practice which has come about in various quarters of selling creosote oil mixed with coal-tar as a No. 1 specification oil, should be stopped; and where No. 1 specification is called for, that the specification for such oil, as printed in the Manual, be rigidly enforced."

As examples of good types of competing commercial creosote oils, all distillates, it is interesting to note the following specific gravities at 38° C. (100° F.): American 1.034, another American, used at Chicago, 1.109; these two having total distillates up to 358° C. (671° F.) of ninety-one and seventy per cent. respectively, and having residues left which are soft and of dark amber color. German creosote oil, specific gravity 1.064; distillate up to 355° C. 80%, leaving soft residue. English creosote oil, specific gravity 1.044, total distillate to 355° C. 90%, residue soft. I note for comparison the pitch mixture or pitch containing oil, not a distillate, which has been used for very few years in some cities of the United States (but not as good as real creosote oils) that it had a gravity of 1.115, total distillates up to 355. C. of sixty-one per cent., and that the residue then remaining was hard, stiff, brittle pitch. This pitch tar oil compound had 3.1% insoluble in hot benzol by the extraction test; while the creosote oils have less than 1% thus insoluble.

Wood pavements have their limited but proper place especially on some interior business streets of large cities; although for the vast majority of streets of all cities, other kinds of pavements, each in its proper place, are more suitable and less expensive.

German efficiency says, "Siehe Alles und behalte das Beste" (see all and retain the best). The English adage says, "Do not remove old land marks." Therefore we must not abandon the use of the kinds of wood (or other pavements) which have succeeded, but retain their specifications and repeat those successes on our streets. I hold no brief for any wood paving interest or material. I speak entirely from the standpoints of public welfare and good professional ethics in engineering. The city engineers and officials of this society certainly agree with me that we must resist commercialism and selfish politics and be wholly governed by that which is best for the interests of the taxpayers, cities, and the nation we serve. In other words, we should be loyal and patriotic in times of peace and not reserve our patriotism for times of war.

* * *

Dr. L. I. Hewes, of the U. S. Office of Public Roads and Rural Engineering, has made some interesting investigations of the cost of hauling farm products. In seven counties he found the average cost of hauling one ton a mile on unimproved roads was 29.1 cents. The range was from sixteen to thirty-seven cents. He also found that the cost of hauling on a system of improved roads varied from two to ten cents less than on unimproved roads. If we consider the average reduction as five cents a ton-mile, then thirty-three tons a day will provide $500 a year and sixty-six tons a day will provide $1,000 a year in savings on the cost of hauling.

* * *

Our main improved roads are going to cost us under the most favorable conditions a considerable sum annually per mile —from $300 to $1,000. To get adequate return for this large rental the road must be kept in condition to render maximum service at all times. This means continuous maintenance, repairs of all kinds intelligently made when needed careful financing and good business management, skilled supervision and engineering services. Under any other conditions we face a serious loss; a loss of fixed capital, a loss of community wealth that must be written off against the economic resources of the county or of the State.

# The Resurfacing of Old Concrete Roads with a New Concrete Wearing Surface

An Abstract of the Advance Sheets of a Report by Edward N. Hines, Chairman of the Wayne County Highway Commission, Detroit, Michigan

WE have a large and constantly growing mileage of concrete roads, and we regard the present the opportune time to determine the feasibility of resurfacing an old concrete road with a thin layer of new concrete. Had any other section of the country undertaken such an experiment, we would have been content to watch the result. However, we hope to put ourselves in a position to successfully carry on a resurfacing job should the need arise, and with this object in view, we have resurfaced a section of concrete road, built in 1910, with a three-inch surface of new concrete.

Grand River Road was selected for this experiment, because we felt that it would receive the severest kind of test, on account of the heavy mixed traffic which uses this highway, and because the section selected was rough and uneven.

This section of road was built by the Owosso Construction Company, of Owosso, in 1910, and is of two-course construction. It is six and one-half inches thick, sixteen feet wide, and built on a crowned sub-grade. The bottom course is a 1:2 1-2:5 mix, four inches in thickness. A crushed limestone was used for the coarse aggregate. The wearing course is a 1:2:3 mix and is two and one-half inches in thickness. In this course, crushed field stone, ranging in size from one-fourth to two and one-half inches, was used for the coarse aggregate. It was put down in twenty-five-foot sections, with one-quarter-inch joints composed of tar paper strips which extended entirely through the concrete slab. The surface was struck off with a template and was somewhat irregular in finish, as we were not as careful and as thorough at that time as regards finishing the surface as we are at the present time. The edges of the road were rounded off with about a three-inch radius, which is a practice which we have since abandoned.

During the week of August 17, 1912, a total of 7,444 vehicles passed a given point on this road, and during the week of September 18, 1912, by actual count, a total of 7,580 vehicles passed the same point, which point is near where we resurfaced the road. Forty per cent., plus, of these vehicles were horse-drawn, and the balance were motor-driven.

This territory has been built up very rapidly since the above traffic count was taken, and an actual traffic count at the present time would undoubtedly show a very material increase in the number of vehicles passing a given point. To better accommodate this increased traffic, we decided to widen the road to twenty feet. In order to do this, we broke off the rounded edge and added concrete on each side of the old road, to bring it out to the desired width. A 1:2:4 mix, six inches in thickness, of concrete in which the aggregate were washed and screened pebbles and washed and screened sand, of the same quality as called for in our standard specifications, was used.

All of the Tarvia surfacing and filler, used to fill and cover the cracks, was removed. These cracks and holes were then filled with green concrete so as to make an even surface twenty feet wide. The expansion joints, as steel protection plates were not used, were mostly worn down. Where the joint was spalled to a considerable extent, the old concrete was broken away sufficiently to furnish a bond for the new concrete on both sides of the joint. Expansion felt was then placed and the whole surface was brought up to an even grade. On the top layer of this base we then placed a three-inch layer of 1:1 1-2:2 1-2 concrete, using Marquette, Michigan, trap rock graded in size from one-fourth-inch to one inch for the coarse aggregate, and washed and screened bank sand for the fine aggregate. The surface in no place is less than three inches thick, and is reinforced with No. 26 Triangle Mesh wire, manufactured by the American Steel & Wire Company. We did not try to bond the top course to the old road with a rigid bond. The surface of the old concrete was first well sprinkled with water, after which a mixture of Tarvia A and Tarvia X was sprinkled on hot with an ordinary sprinkling can immediately before placing the new concrete wearing surface. The Tarvia, falling on the moist concrete, spread in a very thin layer and was immediately chilled, thus forming an even coat over the old surface. The expansion joints in this top course coincide exactly with the expansion joints in the bottom course. A piece of wood three inches by four inches by twenty feet long was laid over the old joint, and the concrete was then deposited as though no joint was to be made. A Baker automatic finishing machine, manufactured by the R. D. Baker Company, Detroit, was used to finish the surface. The use of this machine made the surface perfectly even and smooth, eliminating the waves and roughness found in concrete surfaces where the finishing is done by templates worked by hand.

Afterward, this piece of wood was removed and armor plates, suspended from installing bars, with expansion felt, were set into place on the side forms in such manner that the felt of the new joint met the tar paper of the base joint. We believe that this method is better than pouring the top course directly onto the bottom course, as a slight movement, due to a difference in expansion of the two courses, or of heaving, would result in cracks in the top course if the two courses were rigidly bonded together. The Tarvia, although very thinly spread, permits a slight movement of each course without one interfering with the other.

Before approving of this type of construction, small slabs of concrete were made, a coat of Tarvia was put on top and another course of concrete was deposited directly on the Tarvia. It was found that it was not only impossible to separate these two layers, but that a blow struck on the upper course, and sufficient to crack that course, would also crack the bottom course. The road was covered in the regulation manner to hold the moisture, after the resurfacing course was laid, and then sprinkled daily for two weeks. Traffic was permitted to use the entire road twenty-five days after the last concrete was laid.

The cost of this work, which was $15,573.67, is high, owing to conditions that were encountered at the time the work was undertaken, and this cost should not be regarded as a factor in this particular instance, as it is the determining of a principle that was being undertaken. If the principle is correct, the working methods can be perfected to bring the cost of work of this kind down to where it belongs.

This section of road that has been resurfaced has now been in use for several months, and to date it seems to be apparently a successful experiment. A much longer period of time must elapse, however, before we can make a positive statement regarding its success.

While the section of road was closed to traffic during the construction of the experimental section, we provided a good detour which took traffic only a short distance out of its regular course, and it was necessary to use considerable quantities of crushed stone to put the detour in a fair condition for traffic.

We believe it wise to add a word of caution that this resurfacing is regarded by us as wholly in the nature of an experiment which should be watched and studied, rather than generally advocated, until it has had time to thoroughly prove itself out.

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## Reorganization of the Office of Public Roads and Rural Engineering

OWING to the fact that, under the terms of the Federal Aid to Roads Construction Act, passed by the recent session of Congress, additional and more varied duties have been placed under the charge of the Office of Public Roads and Rural Engineering of the United States Department of Agriculture at Washington, it was necessary to effect a reorganization of that Office. This reorganization became effective November 1, and constitutes a change of more than ordinary importance.

As is now generally known, under the terms of the Federal Aid to Road Construction Act, the Secretary of Agriculture

has delegated the responsibility for the supervision of construction on all Federal Aid roads to the Office of Public Roads and Rural Engineering, so that many changes are necessitated by the greatly increased activities and responsibilities of that Office, which is now unquestionably one of the most important departments or offices of our Federal Government.

Under the reorganization, there are now two main branches, namely, management and economics and engineering. The heads of these two main branches are without any question the two best authorities in the country. J. E. Pennybacker is in charge of Management and Economics as Chief of Management, which is his new title, and it is safe to say that there is no individual in this country who is in closer touch with and who is more of an authority on road matters and subjects in general than Mr. Pennybacker. The engineering head is Captain P. St. John Wilson, so well known from one end of the country to the other that nothing further need be said regarding him or his ability and standing. Mr. Wilson now has the official title of Chief Engineer of the Office of Public Roads and Rural Engineering.

Both Mr. Pennybacker and Mr. Wilson report directly to Logan Waller Page, who continues in charge as Director of the Office of Public Roads and Rural Engineering. In the absence of Director Page, Captain Wilson becomes Acting Director of the Office.

A brief outline of the various departments and divisions of the Office of Public Roads and Rural Engineering will be of interest, and as rearranged are given herewith.

DIRECTOR.—Logan Waller Page, who is in full and absolute charge of the Office, directly under the Secretary of Agriculture. In his absence, as has previously been stated, Captain P. St. John Wilson assumes charge as Acting Director in charge of all departments.

DEPARTMENT OF MANAGEMENT AND ECONOMY.—This branch is in charge of J. E. Pennybacker as Chief of Management, and consists of two main subdivisions, taking care of the duties and responsibilities as shown under each division.

A. Management—J. E. Pennybacker, Chief.
   1. Correspondence and Files.
   2. Co-operation with the Solicitor.
   3. Accounts.
   4. Editorial and Library.
   5. Quarters and Stock.

B. Engineering Economics—J. E. Pennybacker, Chief.
   1. Economic Investigations and Advice.
   2. Statistical Investigations.
   3. Legislative Investigations and Advice.
   4. Lectures and Exhibits.
   5. Illustrations and Models.

DEPARTMENT OF ENGINEERING.—This branch, which consists of five main subdivisions, is in charge of Captain P. St. John Wilson, as Chief Engineer. Each of the five subdivisions is in turn in charge of a chief who reports directly to Captain Wilson. The five subdivisions, with the heads of each, and the duties and responsibilities properly classified are as follows:

A. Road Materials, Tests and Research—Prevost Hubbard, Chief.
   1. Chemical and Physical Tests.
   2. Microscopic Examination and Classification of Rocks.
   3. Standardization of the Methods of Testing.
   4. Investigations of Non-Bituminous Materials.
   5. Research on Dust Preventations and Road Binders.
   6. Concrete Investigations.
   7. Field Experiments.
   8. Inspection and Advice.

B. Highway Construction and Maintenance—Capt. P. St. John Wilson, Chief.
   1. Post Road Construction.
   2. Forest Road Construction and Maintenance.
   3. Object Lesson Roads.
   4. Co-operative and Experimental Maintenance.
   5. Bridges and Culverts.
   6. Inspection and Advice.

C. Irrigation—Samuel Fortier, Chief.
   1. Utilization of Water.
   2. Power and Appliances.
   3. Equipment.
   4. Flow of Water in Ditches, Pipes, etc.
   5. Duty, Apportionment, and Measurement of Water.
   6. Customs, Regulation, and Laws.
   7. Drainage of Irrigated Lands.
   8. Inspection and Advice.

D. Drainage—S. H. McCrory, Chief.
   1. Farm Drainage.
   2. Drainage of Swamps and Wet Lands.
   3. Removal of Surplus Water.
   4. Field Experiments.
   5. Investigating and Developing Equipment.
   6. Inspection and Advice.

E. Rural Engineering—E. E. McCormick, Chief.
   1. Farm Water Supply.
   2. Drainage Disposal.
   3. Construction of Farm Buildings.
   4. Rural Engineering Problems Involving Mechanical Principles.
   5. Traction Tests.
   6. Instrument Making and Repairing.
   7. Inspection and Advice.

There is a General Inspection Bureau created which is in charge of two general inspectors who report direct to the Director of the Office, Logan Waller Page. These two General Inspectors are T. Warren Allen and E. W. James. These gentlemen will inspect general field operations and field work under instructions from the Director.

Directly under the Division of Highway Construction and Maintenance will be the ten field districts that are provided for, and which have been established. Each of these field districts will be in charge of a field engineer who will have his office and headquarters in his particular division, and who will report directly to Captain Wilson. These ten districts, with the States assigned to each and the headquarters, where the latter have been determined upon at this writing, are as follows:

FIRST DISTRICT.—Washington, Oregon, and Idaho. Headquarters not yet assigned.

SECOND DISTRICT.—California, Nevada, Arizona, and New Mexico, with headquarters at Berkeley, California.

THIRD DISTRICT.—Colorado, Montana, Wyoming, and Utah, with headquarters at Denver, Colorado.

FOURTH DISTRICT.—North Dakota, South Dakota, Minnesota, and Wisconsin. The headquarters have not been assigned at this writing.

FIFTH DISTRICT.—Nebraska, Iowa, Kansas, and Missouri. Headquarters have not been assigned at this writing.

SIXTH DISTRICT.—Texas, Oklahoma, Arkansas, and Louisiana. Headquarters have not been assigned at this writing.

SEVENTH DISTRICT.—Michigan, Illinois, Indiana, and Kentucky, with headquarters at South Chicago, Illinois.

EIGHTH DISTRICT.—Tennessee, Mississippi, Alabama, Georgia, South Carolina, and Florida. Headquarters have not been assigned at this writing.

NINTH DISTRICT.—Maine, New Hampshire, Vermont, New York, Massachusetts, Connecticut, Rhode Island, New Jersey, and Delaware. Headquarters have not been assigned at this writing.

TENTH DISTRICT.—Ohio, Pennsylvania, Maryland, West Virginia, Virginia, and North Carolina, with headquarters at Washington, D. C.

These District Engineers will look after the Federal Aid road work in their respective territories, and also all object-lesson roads and experimental work that is done.

* * *

## Michigan Road Plans and Record Keeping

NO matter what type of road is to be built in any given location, the first requirement is a properly designed and well-built subgrade. This can only be obtained with suitable road plans. In this article the essentials of road surveys and map making as developed by the Michigan State Highway Department will be considered together with

the filing methods employed which greatly facilitate the efficient handling of the work.

The first and most important requirement of a good plan is that all the necessary information be accurately and concisely obtained in the field. This information should consist of alignment, topography, soil, present road surface, present drainage, need of future structures, both old ditches and need of new ones, obstructions to construction, and such information as will enable one to intelligently specify what new grades shall be laid, what new drainage shall be put in, and what new drainage structures shall be erected. Having all this information in a concise and legible form, one is ready to start making the plans.

In locations where the old road beds are already established, the work consists for the most part in truing up the grades and adding a metalled surface, and slope stakes are unnecessary. For this purpose the plan contains a plan of the highway showing the centerline of the new roadway with curves, bearings, point of beginning and ending stations clearly marked. Obstructions to construction such as trees, rocks, telephone poles, etc., farm lines, old drainage structures, notes as to the kind, size, and quantities of material, farm entrances, houses, railroads, swamps, creeks, rivers, ditches with the direction of flow, and any other topography which may be required in the construction of the road, are all clearly indicated on the plan. The most convenient scale to use has been found to be 100 feet to the inch. The effort is made to give on the plan enough information so that one may thoroughly understand the conditions with which he has to deal.

In making the survey, two lines of hubs are set distant twenty-five feet on either side from the center line. In plotting the profile, therefore, five lines are plotted, the center line, the two hub lines, and the two lines of the old ditch bottoms if there are any. Ten feet to the inch makes a convenient vertical scale. The bottoms or beds of all cross drainage systems, rivers, and creeks which cross the highway are also plotted. From these notes it is easy to pick out the sizes of culverts needed and to figure their volume.

The highway laws of Michigan require that no State aid be paid on roads having a maximum grade of more than six per cent. This often necessitates large cuts and fills and frequently brings into consideration the question of relocation of the highway. Often it is cheaper to buy land and relocate following a valley. In laying a grade over hilly country, it is well to reduce the grades all that is possible until three or three and one-half per cent. is reached. Below that it is better in nearly every case to true up the old road bed and retain as much as is possible of the hard surface as a foundation for the new metal. The matter of ruling grades also introduces other interesting considerations. If the greatest per cent. of grade on the road is six per cent., it is undoubtedly advisable to reduce the average rise and fall to about three per cent. as far as possible. But one should remember that the highest grade rules and, therefore, that large cuts to get the three per cent. or so grade should not be made without due consideration given to balancing their cost against the reduced tractive effort given by the low grade. If, however, the greatest grade on the road is not over three or three and one-half per cent., the making of extensive cuts and fills to reduce the grades to one or two per cent. is not justified. The effort should rather be to eliminate any abrupt changes in the grade line and to produce an undulating grade which more nearly follows the lay of the land. Also it is never wise to make long shallow cuts or fills where only one or two-tenths is excavated or filled. Grades constructed in this way are expensive.

The method employed by the Michigan State Highway Department is to lay a temporary grade first and to see that it balances as closely as possible. This grade is then checked in the field so that any items which the notes do not show may be taken into consideration and the grade corrected accordingly. After field checking the grade and profile is finished. The center line grade shows the center cuts and fills and is tied to both lines of hubs.

The method used in figuring volumes for balancing cuts and fills is based on a flat top section. Sufficient levels are taken in the field so that the surface of the ground may be accurately plotted at each station and at all plus stations where there is sufficient break in the ground to warrant it. These stations and the new section are plotted, both to a scale of one inch equals ten feet. The end areas of the prisms are then calculated with a planimiter. The volumes may be figured in the usual way or taken from tables. These volumes are not as accurate as those obtained when slope stakes are set and the actual limit of the section found on the ground, but they are accurate enough for estimating purposes. Where there is a large amount of yardage slope stakes are set and the final estimate based upon this work.

After the center line grade, the vertical location of the ditch grades is important. The drainage is the big item in flat country. The new ditch grades are laid out and referenced to the nearest hubs. On plans sent in to the Department the side ditch grades are sometimes laid out so that they intersect the bottom of the cross drainage where this is unnecessary, instead of keeping them up and allowing the water to drop into the cross ditch. When grades are laid in this way there is liability of having back water in the road ditches when the water is high and the ditch grades are flat. This should be guarded against.

In the Upper Peninsula of Michigan, many of the roads are laid out anew. Here it is possible to locate the roads much the same as a railroad grade, taking advantage of the topography to secure easy grades where possible. Such work is slope staked and this makes the matter of road plans much easier. It is only necessary to show the layout in plan and the center line profile and grade with cuts and fills. The cross section book takes care of the volumes and the grade is established on the ground by the slope stakes. The ditching is taken care of on a unit of length basis, under separate contract, or by force account.

The matter of filing profiles for handy reference is one that every engineer must work out for himself, to fit his own particular needs. The method used by the Michigan State Highway Department is to make all sheets of a standard length —five feet—and then to put them in a plan file where they are held flat and in a vertical position. The file is indexed by counties and townships and all drawings in the same township receive the same file number. Special road plans are indexed as a whole and cross reference is made in case they lie in more than one township or county.

If a county has an established county road system with roads named, the plans could be filed under the name of the road to which they belong. Each succeeding plan could be tied on to the last one by continuing the stationing so that when the road reached the county line a complete plan under one file number could be found without trouble. Another way would be to file by townships and number the roads within the townships. This would not be feasible, however, where a large number of angling roads are found.

Any file system to be worth anything should be kept up to date. Each drawing should be filed as soon as started and kept in its place in the file when not in use. Nothing is more exasperating than to go to a file and not find what one is looking for because of some one's carelessness. One should not get so complex a system of indexing that it is more trouble to index it than to make the drawing. When such is the case the temptation to postpone filing is too great and the filing is usually left undone.

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## North Carolina

THE work in Wayne County has been progressing at the rate of about two and one-fourth miles per month on construction work. They have machined and dragged all of the improved roads, and a great many of the important unimproved roads, thus keeping the primary highways in the county in very good condition. Due to the scarcity of prisoners they have been considerably, you might say materially, handicapped for over two months, having had only an average of thirty-one prisoners divided into two construction forces. Five and one-half miles of the Central Highway leading east from Goldsboro has been built, sand-clay base, with gravel surface, since June 1, and is in splendid condition. There remains only about one and one-half miles to be built to complete this end, which will be finished early in December. Since the middle of May the road leading from Goldsboro to Sampson County has been relocated and built for five and one-eighth miles. During September and October they have constructed two twenty-foot reinforced concrete bridges near

Fremont, at a cost of about $700 each, and have substituted Ajax Segment Block Culverts for wooden culverts in six or eight places. The estimated cost of the construction of these roads is $800 per mile.

SAMPSON COUNTY.

In Sampson County the convict force has just completed the work around Roseboro and have moved near Clinton. There is work being done in nearly every township in the county.

WILKES COUNTY.

In Wilkes County the engineers have already begun the location of their system of roads, which will cost $275,000.

WILMINGTON-CHARLOTTE HIGHWAY.

The work on the Wilmington-Charlotte Highway in Robeson County has not been making very rapid progress, but the Robeson section is now complete, with the exception of about five miles.

CHARLOTTE-ASHEVILLE HIGHWAY.

The work of reconstructing the Charlotte-Asheville Highway was begun about September 15, and the first monthly estimate showed that about twenty per cent. of the work on the Rutherford County section was completed. The work has been moving steadily during the month of October, and this road will be open for traffic in the early part of next year. The new road, when completed, will be much better as to alignment and grades than the road which was destroyed by the flood. The new road will be surfaced with sand-clay or top-soil. The relocation of the Henderson County section is now being made, and as soon as the State convicts can be secured the work on this division will be begun. It is expected that the entire road from Charlotte to Asheville will be completed early in 1917.

LOUISBURG BRIDGE, FRANKLIN COUNTY.

The splendid concrete bridge in Franklin County has just been completed. This bridge was designed last February by W. S. Fallis, State Highway Engineer, and Bridge Engineer W. L. Craven, of the State Highway Commission. Plans for the bridge were furnished by the State Highway Commission, and it was built under the general supervision of the Commission on what is known as "Force Account."

* * *

## Oklahoma

THE months of October and November, in the State of Oklahoma, have been marked by the large number of contracts that have been awarded for the construction of bridges. As the annual work of the State Board of Equalization and the County Excise Boards was not completed until late in July, the County Commissioners were unable, until the regular August meeting, to instruct the County Engineers as to preferred order of construction of projected work and in addition, many projects were deferred until the outcome of the General Primary on August 1.

As a result, plans were prepared during August and advertisements made and lettings held after the regular September meetings. The result of these lettings was almost uniformly satisfactory and, because of the greater competition engendered by the publicity given under the 1915 and 1916 Highway laws, several counties were able to let bridges heavy enough to comply with the standard loading, and with properly proportioned foundations, for smaller lump sums than were paid before the 1914 General Election for bridges of the same span, much lighter and set on I beam piles. This, too, in the face of tremendous advances in the prices of steel, lumber, labor, etc. In many counties, such decided savings were made that the Commissioners planned more work from the money saved and lettings were held in the first week of November, to provide for the spending of these unexpected funds.

Governor Williams made a speaking trip early in the month of October, through the eastern part of the State, during which trip he spoke in the interests of good roads in several counties, but particularly in Washington County, where an issue of road bonds is proposed and in Tulsa County where it is proposed to use regular levies and Gross Production Tax in the building of a permanent road from the Washington County line to the Creek County line.

The first steps in the Tulsa County improvement have been taken, in the letting of contracts for the construction of six miles of the Tulsa-Sapulpa Highway of Lithomastic on a macadam base and in advertising for bids on the construction of the same pavement on a concrete base for the approaches to the new arch bridge across the Arkansas River at Tulsa. The Commissioners of Tulsa County have leased a quarry and a crushing plant about three miles from the west part of the city and are now operating same with State convicts, a crew of thirty men having been assigned to Tulsa County for use in this plant and on the roads.

Creek County has awarded contract for the construction of one mile of concrete pavement on the Sapulpa-Kiefer road and work on same was begun on November 4. This is the first step in the building of an important link of the highway system as there is a heavy traffic between these two points.

The Highway Department assigned Mr. Chas. Ensminger to assist Mr. M. E. Binckley, County Engineer of Creek County on some road work and Mr. Ensminger located State Road from Bristow to Kelleyville, securing a most satisfactory line on a grade not exceeding two per cent. through a very rough country. This road is on one of the alternate routes now in competition to secure the permanent location of the Ozark Trail.

The Commissioners of Okmulgee County, after receiving a petition signed by over fifty per cent. of the voters in the county, called an election on the question of providing approximately $800,000 to build a system of hard surfaced roads through the county. This question was voted on at the General Election, November 7, and was carried by a three to one vote. Okmulgee County is the first one to take advantage of the revision of the laws permitting the financing of the construction of hard surfaced roads by bond issue. Several other issues are proposed, but have, for various reasons, been held up.

The election of many County Commissioners, pledged to a constructive road building policy, is assured and it seems that the future of road building is very bright. Seventy-five per cent. of the incoming County Officials will expect to devote most of their time to road and bridge work although many of them will be handicapped by the fact that Road and Bridge and County Road Construction Funds will be exhausted by their predecessors and only State Highway Construction fund will be available until estimates are made for the new year.

The number of good concrete culverts on the road programs shows that the specification calling for "permanent" openings is having a most satisfactory effect. Several of the Western Counties are, moreover, making good use of low-water crossings and paved fords, in crossing small streams, dry for 360 days in the year and having flat slopes on the approaches. Alfalfa County has built fifteen of these from the 1916-17 levy and their experience with them in the preceding year seems to warrant these expenditures.

Woodward County has completed 750 feet of low-water, slab-floor trestle across the North Canadian River at Woodward and the Commissioners are building 600 feet of similar construction over Beaver Creek at Fort Supply. These bridges are giving entire satisfaction and two or three similar openings are provided for in the present Tax Levy.

The County Commissioners of Pushmataha County have awarded contract to the Lisle-Denning Construction Company for the building of forty-five miles of grade, with the necessary culverts and paved fords, in Tuskahoma Township, of that county. This is at an approximate cost of $900 per mile and it is not believed that it will be possible to do everything the Commissioners want to do, for the money available.

The Attorney General has given the Highway Department his opinion to the effect that it is a violation of the Oath of Office for any County Official to accept his traveling expenses or any other emoluent from any bridge, material or machinery company either before or after the articles in question were purchased, or even if nothing is purchased in spite of the fact that he may be assured in writing that payment of expenses is made as a part of or in lieu of customary selling expense by the manufacturer.

Inspections have been made by the Highway Department of protested road locations in Mayes, Blaine, Dewey, Tulsa, and Custer Counties and an inspection of the sewer system of Ok-

mulgee was made, with recommendations as to construction of an intercepting sewer.

A temporary restraining order has been secured preventing the Commissioners of Washita County from revising location of State Road near the town of Dill. The motion to dissolve will be heard on December 23, at Cordell.

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## Bond Issues vs. Politics in State of West Virginia

By Carl P. Leatherwood

THAT the matter of building good roads should never under any circumstances be connected in any way with politics is further evidenced in West Virginia where five bond issues aggregating $1,481,000 were defeated at the general election held on November 7. The previously predicted outcome of the recently proposed bond issues has somewhat blackened the good record in road building in West Virginia, which until the general election was fast assuming the lead among the other States in the Union. The movement for better roads in this State is still in its infancy, and while the law permitting taxing units to issue bonds to secure money to build roads has only been in existence for a very few years, almost $15,000,000 have been appropriated.

In most instances the officials in the units which voted on bond issues at the election, were forewarned as to the inadvisability of mixing good roads with politics but they persisted in voting on the proposition with the above disastrous result. The unfortunate results however, will have their good effects in the future. Good roads bond issues and politics should not be on speaking terms. They should be divorced in the fullest meaning of the word. The interests of both are separate, distinct and individual. Politics represent the interests of partisans while good roads represent the interest of the masses. The interests of one are selfish and oftentimes mercenary, while those of the other are democratic and universal.

In a few of the districts where the issues were voted upon in this State, they were made political issues. Candidates openly and publicly announced themselves as favorable or opposed. In some cases the defeat or election of several of the candidates can be traced to the position they took on the pending bond issues. In Lewis County where a $1,000,000 issue was defeated, several of the candidates made an effort to the neutral but they were forced to show their hand and announce their position before the campaign was ended. The voters in most districts were indifferent, as they were too concerned about political issues. They didn't have time to give good roads a thought in the heat of the campaign as other issues predominated. The candidates were too busy talking about themselves and their parties to mention good roads in their outbursts of oratory. Every one else was too busy to ask them any questions so the bond issues were completely lost sight of in the wild scramble for office. Thanks to the broad mindedness of several of the officials in other taxing units in holding off their elections until after the first of the year or a greater setback would have been given the movement.

Contractors throughout the State are now closing up the season's work. Concrete is being laid in only a few localities and the end of the month will see the work stopped completely. Grading will be continued until cold weather and the coming spring will see more actual construction of hard surfaced roads than at any other time in the history of the State. The majority of the lettings will be held over until next spring, as it is almost impossible to get bids on any road work in this State at this time of the year.

Wood County's concrete roads continue to be inspected as model roads. On October 30 and 31, sixty influential men of Washington County, Pennsylvania, including the county officials and members of the Chamber of Commerce, composed an inspection party of Wood County's roads. The visitors held a banquet at Hotel Chancellor in Parkersburg, on October 30, and oratory flowed in streams. Several representatives of the Parkersburg commercial organizations were present and delivered speeches. The trip from Washington to Parkersburg was made in a special Pullman car and automobiles were provided for the party upon the arrival in Parkersburg. The concrete roads in Washington County, Ohio, were also inspected and all the visitors departed fully convinced that concrete was the logical type of road for Washington County.

## What Good Roads have Actually Accomplished

THAT maligned person, the "tight wad," has his uses. It is a good thing his reluctance to become separated from his earned or unearned increments occasionally gives pause, even checkmate, to the enthusiasm of the promoter of good things, real and imaginary. Take the case of the advocate of rational road improvements. His studies and investigations have shown him that bad roads increase the burden of the farmer, dull the life of the farmer's wife, check the schooling of the farmer's children, keep the doctor away from the sick chamber when he is needed, and even diminish the solace that is derived from regular church attendance. He knows, and everybody else knows, that this keeps back the development of high-grade farming, which in turn gives a push upward to the cost of farm products. All these things are perfectly true.

The advocate of sensible road improvements tells the crusty "tight-wad" that engineers have reported a road can be built for a stated sum, and will he please support the movement because it will help to keep the high cost of living from soaring higher. The financially close party asks for proof, and receives the above explanation. His service to the world is then illustrated. "Such things are mere platitudes," he asserts, "they are mere generalities. You must show to me by definite figures that the roads are worth their cost, before I shall part with the fruits of the labor of my hard-working employees." This rejoinder has revealed the fly in the ointment for glossing many deserving attempts to make road improvements appeal to the man with a close fist encircling a large bank roll. Yet it is a perfectly sound position for him to take. The great English scientist, Lord Kelvin, once stated that people know little about most subjects until they can discuss them in measured quantities. The value of road improvements has not been capable of definite discussion, the kind of discussion which influences many able business men, because there has been no measure of actual results accomplished by such betterments.

We have at last definite knowledge. Uncle Sam's road-building bureau, known as the Office of Public Road and Rural Engineering, has a division devoted to the study of the economical relations of roads to the public. It has been quietly accumulating positive facts to show that improving roads and then maintaining them properly brings a financial gain to the community that does these things. The condition of eight counties just before road building began was very carefully investigated, and a similar investigation was made each succeeding year for a period of five years. The results are given in full detail in Bulletin 393 of the United States Department of Agriculture. It was written by J. E. Pennybacker, chief of road economics in the Office of Public Roads, and M. O. Eldridge, one of his assistants. It supplies the information the "tight-wad" has been cynically requesting these many years, and sweeps away the most serious, because partly justifiable, criticism of road improvements. At last we can give definite figures of what good roads have done under radically different conditions.

Eight counties furnish this information. Franklin County, New York, runs down from the plains along the St. Lawrence in the north into the Adirondacks in the south. It has an area of 1,678 square miles, about 46,000 population, and the largest town is Malone, with about 6,500 inhabitants. The principal industries are dairying, lumbering and the entertainment of summer visitors.

Spotsylvania County, Virginia, has an area of 401 square miles north of Richmond and was so thoroughly shot to pieces in the Civil War that for half a century it slowly drifted downgrade. The population is about 16,000; the largest town is Fredericksburg, with 6,000 inhabitants who contribute nothing to county road improvements; the principal products in 1910 were timber and cross-ties.

Dinwiddie County, Virginia, is south of Richmond. It has an area of 521 square miles, of which four-fifths was classed as farming land in 1910, although only one-third of the farm area was improved. In that year the population was 39,000, of which 24,000 was in Petersburg and not subject to tax for county roads.

Lee County, Virginia, is in the southwestern corner of the State and has an area of 433 miles, varying in character from gently rolling farm land to rugged mountains. It has many blue-grass pastures where beef cattle are raised and is also

cultivated extensively. The population was 24,000 in 1910 and there are no large towns.

Dallas County, Alabama, has 940 square miles of rolling land, of which about two-fifths are cultivated. Cotton is the leading crop. The population was 53,000 in 1910, of which 13,600 was in Selma.

Manatee County, Florida, has 1,337 square miles of flat land just below Tampa Bay. Only two per cent. of this area was farmed in 1910 and the resident population was only 9,550, although visitors increased this number materially during the winter. Citrus fruits and vegetables form the products of this semi-tropical section.

Lauderdale County, Mississippi, has 770 square miles of hilly land, of which about one-fourth is cultivated. It furnishes cotton, cereals, peas, potatoes, yellow pine, and beef cattle principally. The population was 47,000 in 1910, of which 23,000 was in Meridian.

These eight counties represent, therefore, typical dairying, farming, mining, and lumbering conditions, before and after the construction of roads. The amount of road improvements done in each of them, which produced the improved financial and social conditions which will be stated, was as follows:

| *County* | *Miles of Roads* | |
|---|---|---|
| | *Total* | *Improved* |
| Franklin, N. Y. | 1,370 | 369 |
| Spotsylvania, Va. | 400 | 83 |
| Dinwiddie, Va. | 524 | 101 |
| Lee, Va. | 450 | 105 |
| Wise, Va. | 300 | 146 |
| Dallas, Ala. | 1,000 | 218 |
| Manatee, Fla. | 575 | 64 |
| Lauderdale, Miss. | 800 | 147 |

The government experts state in full detail the results of the road improvements in each of these counties, and the methods employed in ascertaining these results. The investigations were not hasty observations from a buggy or automobile; they were painstaking searches through real estate transfers, public records, railway reports, school reports and like sources of information, studied on the spot until their accuracy was fully established. They were made from year to year, moreover, to make sure that the local conditions were fully understood and the annual effect of a road improvement was ascertained beyond question.

Real estate transfers showed that the percentage of increase in the value of rural property along these improved roads in about five years was as follows: Franklin, nine to 114; Spotsylvania, sixty-three to eighty; Dinwiddie, sixty-eight to 194; Lee, seventy to eighty; Wise, twenty-five to 100; Dallas, fifty to 100; Manatee, fifty to 100; Lauderdale, twenty-five to fifty. The transfers on which these figures are based are mostly for property within a mile of the improved roads.

In each county the extent of the districts sending vehicles to the improved road was carefully determined in much the same way that the drainage area of a stream is ascertained. The products of these districts and the proportion of them hauled over the roads were then ascertained. The railway shipments from and into the districts were investigated. In case of doubt the actual travel on the roads was ascertained by counts of the vehicles and their loads. The average length of the haul on the roads was found out. From all these statistics, given in detail in the report, it is shown that the cost of hauling one ton one mile on the roads of these counties was decreased from an average of 33.5 cents before highway improvements were made to 15.7 cents afterward. This saving of 17.8 cents per ton per mile amounts to $627,409 in all. To accomplish it the financial burden amounted to only 6.3 cents per ton per mile, leaving a net saving of 11.6 cents per ton per mile.

In addition to showing by detailed figures how the value of land is increased and the cost of hauling is decreased by road improvements, the United States experts have given definite figures of the social improvement due to road betterments. It is not yet possible to state in numerals how much better a man is for attending church regularly or how much better a farmer's wife is for driving over a good road whenever she wishes to call on her neighbors. But there is one thing to which everybody will agree; the grammar schools of our rural territory are one of the great defenses of our national prosperity, and the education of our children is one of our best safeguards for the wise government of our republic. And so even the man who guards his money as a Turk guards his harem will admit the importance of these figures: In the eight counties examined, the average school attendance increased from sixty-six out of every 100 pupils enrolled before the roads were improved, to seventy-six out of every 100 after the improvements. Ten per cent. more children were helped, therefore, to become better citizens by an increase in taxation for roads amounting to only nine per cent. of the total tax for all purposes.

With such clean-cut reliable statistics before us, we need no longer fear the criticism that the rising tide of opinion for rational road improvement is due to sentiment or public hysteria. The task is to satisfy this desire in a wise manner and to reduce the present enormous waste of taxes in poorly managed road work. The country needs the help of the cautious, critical "tight-wad" there more than ever, for it is a field where financial skill and an economical instinct, in co-operation with good engineering judgment, can accomplish great results.—*American Highway Association.*

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## Brick Institute to Hear Live Topics

The forthcoming meeting of the Paving Brick Institute, to be held at the Statler Hotel, Cleveland, Ohio, on December 5 and 6, will discuss a program replete with valuable information to the operating departments of the industry.

Such subjects as "The Use of Powdered Coal," "Producer Gas in Burning Brick," "Equipment Efficiency," "Labor," and "The Development and Application of a Bonus System" are of outstanding worth and give promise of a lively discussion.

The men to whom these subjects have been assigned have each given serious consideration to the particular one upon which they are to speak and many points of value to the industry will be brought out.

The meeting will close with a dinner on the evening of the sixth, for which a live program is being prepared.

The details of the meeting are as follows:

December 5, 10:00 a.m.—Meeting of Program Committee.
December 5, 3:00 p.m.—Meeting of the Institute.
December 6, 10:00 a.m.—Institute meeting.
December 6, 6:30 p.m.—Dinner.

The meeting of the Institute, scheduled for the morning of the sixth, will be continued for the afternoon, if necessary, or if time is available, there will be an inspection trip of interest to all members.

The following papers comprise the program:

"The Use of Powdered Coal," by Mr. A. A. Holbeck, of the Bonnot Company, Canton, Ohio.

"Producer Gas in Burning Brick," by Mr. John T. Underwood, Inventor of the Underwood Producer Gas Burning System.

"Equipment Efficiency," by Mr. F. R. Kanengeiser, of the Bessemer Limestone Company, Youngstown, Ohio.

A paper by Mr. George D. Orr, of the Purington Paving Brick Company, Galesburg, Illinois, on the subject of "Labor."

"The Development and Application of a Bonus System," by Mr. S. M. Duty, of the Medal Paving Brick Company, Cleveland, Ohio.

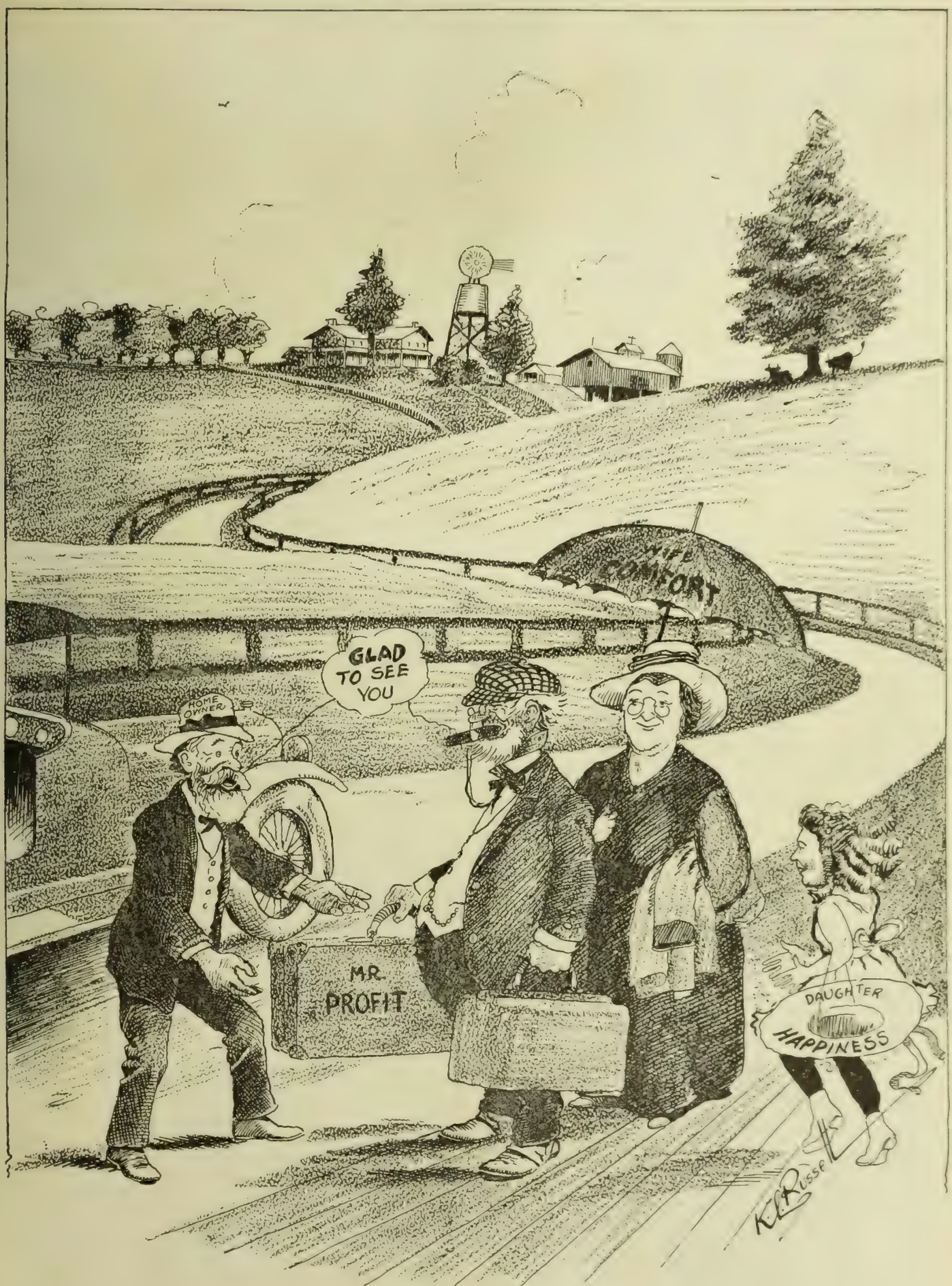
The caliber of the subjects and speakers should merit the widest interest and attendance throughout the industry.

An important meeting of the Cost Committee of the Institute will be called prior to the meeting, to prepare a report to be made at that time.

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## Outline for the Study of Bitumens

Arranged in convenient question and answer form with space for additional memoranda, the Barber Asphalt Paving Company has published an "Outline for the Study of Bitumens." While the whole subject of bitumens is covered, the outline has been prepared with especial reference to the asphaltic materials used in highway construction. In addition to the answers provided in the outline itself, there are references to most of the standard text-books on highway engineering. While prepared especially for school use, the Outline is a convenient means of reference for any one who finds it necessary to investigate the differentiation and characteristics of bitumens.




GOOD ROADS BRING GOOD PEOPLE

# Part of the Motor Vehicle in the Congestion of Traffic in Our City Streets

By Nelson P. Lewis, Chief Engineer of the Board of Estimate and Apportionment, New York City

AN abstract of a most interesting talk on the above subject by one of our best authorities, and delivered at the annual dinner of the American Road Builders' Association, November 3, at the Automobile Club of America, New York City.

* * *

Among the most difficult problems presented to road builders and road planners is that of street traffic. The increase in the volume of this traffic has been most sensational during recent years, especially since the use of the motor vehicle became general. While this increase is quite obvious in all cities, the statistics of street traffic in London, England, are usually complete, and the reports of the London Traffic Branch of the Board of Trade of that city bring out some remarkable facts.

The number of horse-drawn cabs licensed by the Metropolitan Police, which is in charge of this work in London, decreased in nine years from 11,404 in 1903 to 2,382 in 1912, but during the same period the number of motor cabs increased from a single cab in 1903 to 7,969 in 1912. During the same period, the number of motor omnibuses increased from thirteen in 1903 to 2,908 in 1912, and although there were 3,623 horse-drawn omnibuses in 1903, there is not a single one licensed in London to-day.

Some remarkable statistics are given as to the number of vehicles passing certain points at certain hours during the day. The surprising feature, however, of these statistics is that the total number of vehicles licensed in 1912, including tramway cars, was actually 203 less than was the number in 1903. No better illustration is afforded of the enormous increase in the service rendered by motor vehicles owing to their higher speed and to their far greater flexibility.

On certain streets of all busy cities the number of vehicles is so great, and the resulting congestion is so serious, that students of this problem have become much alarmed and are discussing the need of more effective traffic regulation. The easiest solution of this problem appears, however, to be the better diffusion or distribution of traffic, and this can in no way be more effectively brought about than by a better and more uniform standard of improvement of the roadways of both urban and rural highways.

Why is it that so many drivers of vehicles tend to use the same street when many different possible routes could be followed? Undoubtedly the chief reason is that they desire to use the streets that are the best paved and which present the smoothest surface. In the case of the motor vehicle, a slight detour with a correspondingly slight increase of distance, is of little consequence, and time will in most cases actually be saved by the avoidance of traffic congestion, but those who are riding, especially for pleasure, prefer to follow the streets which are most attractive and those on which the abutting property has been improved to a higher degree and in a little more sightly manner. When our streets shall have become uniformly well paved, and when the property along them shall have been improved according to better standard, not necessarily with palatial homes, but with good taste, when tree planting is taken up more seriously, and when the space not needed for roadways and foot paths is devoted to grass plots or planted with shrubbery, those with whom time is not the most important element will follow these streets now given over almost wholly to the delivery wagons of the milkman, the grocer, and the butcher, and appreciable progress will have been made in the solution of the traffic problem.

There is, however, a very serious problem which has grown out of the use of motor vehicles, namely, the increasing weight, the increasing wheel loads and the increasing size of these vehicles. The motor of the tractor can overcome grades with heavy loads which were impossible to the horse-drawn vehicle, and highway officials responsible for the maintenance of our city streets and of the country highways leading out of the cities, are greatly concerned at the damage inflicted upon road surfaces by these loads. The only effective remedy appears to be the enactment of drastic ordinances and laws which will absolutely prohibit the use of vehicles having more than a specified load per inch width of tire, and that load should probably be less for steel tires than for rubber tires.

The width and the length of such vehicles is a matter of serious concern, especially on city streets. Where roadways have been designed to accommodate a certain number of lines of traffic and the number of lines is reduced through an increase in the width of the vehicles, the capacity of the roadway is reduced in still greater proportion and, if this increase in width is allowed to proceed, very costly street widenings will become absolutely necessary. In this case also it would appear to be necessary to prohibit absolutely the use on our highways of vehicles having more than a certain specified width. The State Legislature of Pennsylvania in 1913 passed a law prohibiting the registration of motor vehicles exceeding ninety inches in width of load and vehicle combined, except that motor busses for carrying passengers may be used within the limits of cities of the first, second, and third classes, having a total width of one hundred inches. This law also prohibits loads in excess of 18,000 pounds gross load on any axle, or 750 pounds for each nominal inch of width of solid tire.

Fortunately the tendency of the manufacturers of motor trucks appears to be in the direction of more moderate loads. Of 221 manufacturers producing commercial vehicles at the beginning of the present year, 133 confined themselves to the manufacture of trucks of less than three tons capacity. Of the eighty-eight manufacturers offering trucks of more than three tons capacity, twelve appear to have increased this capacity in their models for this year, but only two of these increases are to six tons, while six manufacturers have decreased the capacity of their trucks, one from four to three and one-half tons and one from seven and one-half to five tons. Of twelve newcomers in the field, only one offers a truck with a capacity of six tons, and two with capacities of five tons, while the rest provide for trucks of smaller capacities.

While the imposition of an absolute limit upon wheel loads and upon the dimensions of vehicles seems necessary to preserve our highways, both in the city and in the country, the development of the motor vehicle appears on the whole to present no problems to highway officials, especially problems relating to street congestion, which will not solve themselves with the more general improvement of our streets and roadways, and with the adoption of a higher standard of real estate development which will make the subsidiary highways more attractive to those using motor vehicles.

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## Short Course in Highway Engineering at the University of Illinois

The Department of Civil Engineering of the University of Illinois announces that in co-operation with the State Highway Department the fourth annual Short Course in Highway Engineering will be held at the University on January 8 to 19, 1917.

The program is now in course of preparation. It is planned to interest those engaged in the development of country roads, the administration of municipal affairs, and contracting. Each subject will be handled by a specialist. The program will include men well known in the field of highway engineering.

It is intended that the course shall be a continuation of the work of last year for those who have attended previously, but courses will be arranged for those coming for the first time. The subjects treated will include social, economic, and financial problems of road improvement, road laws, and their administration, and the various technical problems of road and bridge construction. Special attention will be given matters related to bond issues and the development of county-road systems.

The course is open to any one interested in highway problems without examination or other pre-requisite, and no fee will be charged.

# Going in Debt for Good Roads*

By M. C. Eldridge, Assistant in Road Economics, Office of Public Roads and Rural Engineering

THE subject of ways and means of obtaining better roads is one in which every one should be interested. The time has passed when it is necessary to discuss the benefits of good roads, because every one realizes that good roads are beneficial; the important thing at the present time is to know how to obtain good roads. We are now spending in this country about 250 million dollars annually in building good roads. At the present time, there are outstanding in the United States about 375 million dollars of road and bridge bonds. If every dollar of this money were wisely and economically expended, we would have good roads everywhere in a very short time, but unfortunately that is not the case. We need more economical and efficient methods of raising and handling road funds in order that every dollar expended will accomplish a dollar's worth of work.

There are two ways by which funds are raised for good roads. One is by direct taxation, and the other is by borrowing the money or by going in debt. If a community is able to do so, it should by all means pay as it goes. It should levy a sufficient tax to build and maintain roads and avoid paying interest on borrowed money.

The chief advantage in the cash tax system lies in the fact that no interest charges have to be paid by the present or future generations. There are, unfortunately, many undeveloped communities in the United States in which it becomes advisable to borrow the money for road building in the same way that farmers borrow money to buy farms. If some farmers had to wait until they had the money to purchase their farms, they would probably never become land owners. The same is also true of many counties in which systems of good roads are urgently needed to develop the resources and reduce the hauling costs. They would have to wait indefinitely for good roads if they had to depend upon a cash tax for the necessary funds. Unless a community is able to raise by a cash system of taxation enough money to finance the building of its main market roads within a reasonable length of time, the benefits resulting from the improvement are apt to be piecemeal. On the other hand if a sufficient amount of money is raised either by direct tax or by a bond issue, the resultant benefits are immediate and certain, provided of course, that the money is wisely and judiciously expended under competent supervision.

Competent supervision is the crux of the whole matter. The pay-as-you-go plan too frequently involves a too small annual appropriation with a relatively large outlay for supervision and maintenance, or what is still worse practically no supervision or maintenance. With a larger fund the county can better afford to employ competent supervision and do the work on a large scale or by contract. It is usually cheaper to do road work on the wholesale than on the retail plan. It is relatively cheaper to build twenty or thirty miles of road a year than two or three miles a year.

It is urged by those who are opposed to "Going in Debt for Good Roads" that the interest on the money invested amounts, in some cases, to two or three times the original cost of the improvement. If the right kind of bonds are issued and the money is wisely spent, the interest charges will not be two or three times greater and the benefits will usually far outweigh the interest on the funds invested. "Going in Debt for Good Roads" should be looked upon as an investment and not as an expense, and before a county invests its money it should be certain that the investment will pay.

A man from New Mexico told me yesterday that his county, a few years ago, invested in a bond issue to build a system of good roads and that a recent traffic study had shown that the saving in hauling costs amounted to about $20,000 a year, which would be sufficient to pay for the whole bond issue, interest and principal, in about seven and one-half years. This was a good investment. Another gentleman told me a day or so ago that a county in Texas invested only four or five years ago in road bonds with which to build about twenty miles of roads, and that practically nothing has been spent on those roads for maintenance and that the roads have been almost entirely destroyed by the traffic and the elements. This was probably a good investment in the first place, but it was not safeguarded by proper maintenance. A county may properly borrow money to build roads, but should be required by law to set aside a sufficient annual tax to maintain its roads in good order so that the investment will be safeguarded.

Before a county invests in road building, it should determine first, the traffic area for the roads to be improved; second, the present and future traffic expressed in ten miles per annum; third, the estimated cost of hauling per ton mile at present and what it will be reduced to by the improvement; fourth, the roads to be improved and the probable cost of the improvement as borne out by these facts and by surveys and estimates made by a competent engineer; fifth, the present value of the lands abutting the roads and the increase in value which will probably result from the improvement; sixth, the present school attendance and the possibilities for school consolidation and increased attendance which will result from better roads; and seventh, the amount of tax that will be necessary to finance the undertaking whether the work is carried on by direct taxation or by funds derived from a bond issue.

A study of these facts will enable a county to determine whether it can afford to invest in good roads, how much it can afford to invest, how many miles of road it can afford to build, and what kind of roads it will be most profitable to build. Such a study will usually show that about twenty per cent. of the roads carry about ninety per cent. of the traffic, and that the first requirement of the average community is the improvement of about one mile of road out of every five miles in the county. It will also be found that it is not necessary to expend the same amount of money on all of the roads. For instance, one road may carry from four to five times the volume of traffic one or two miles out of the county seat or main market town, as it may be required to carry ten or twelve miles from town, and consequently the county can afford to spend four or five times as much for the construction and maintenance of the first and second mile as for the tenth or twelfth mile. The greatest good to the greatest number can be accomplished by carrying this principle into practice.

If the county decides to go into debt for good roads, it should decide in advance what kind of bonds are to be issued, whether long term bonds or short term bonds, whether sinking fund bonds or serial bonds. The people of a county would do well to consider the advantage of short term bonds for temporary improvements and long term bonds for work which is more or less permanent, and serial bonds over the ordinary sinking fund bonds.

I know of a county, which issued thirty-year sinking fund bonds without providing a sinking fund. In 1910 these bonds became due and were retired by another issue of refunding bonds and again without providing a sinking fund. You will all agree that this is poor financing. It frequently happens that bonds are issued covering a term of fifty years and that by the time the bonds are paid, the interest charges amount to twice or three times the cost of the work performed. The aggregate of the approved State bond issue in one of our great and wealthy States for 1914 amounted to $5,000,000 bearing interest at four and four and one-half per cent. and covering a fifty-year term before all would be redeemed. The State Comptroller of that State calculated that the interest at the end of that time will have amounted to $8,800,000, or in round numbers $3,000,000 more than the total issue. In other words, the cost to the State will be almost $14,600,000 for the privilege of doing $5,800,000 worth of work. It is a question whether the convenience is worth the price for a portion of the indebtedness is apt to long outlive the life of improvement.

The character of bonds to be issued for road building is a matter that has been sadly neglected. Many millions of dollars could be saved annually if the serial bond plan were adopted instead of the sinking fund plan. To illustrate this point let me explain the difference of the two plans, and the saving which would result from adopting the serial method: Under the serial plan a certain amount of bonds is retired each year

(Continued on page 34)

*Address delivered before the International Farm Congress, El Paso, Texas, October 21, 1916.

## The New Jersey State Commission of Roads

IT will probably be a surprise to many of our readers to learn that Colonel E. A. Stevens, for a number of years past State Road Commissioner of New Jersey, will, in all probability, retire from that office shortly after the first of the year. Commissioner Stevens expressed his intention some time ago of retiring at the expiration of his term, which will be next February, and he hopes to be able to do so after the report of the committee, of which he is chairman, which is preparing a revision of the road laws of the State, is submitted to the legislature early in January. This will probably be the only important change in the office, as all engineering positions are protected under the civil service laws of the State.

There is but one successor to Colonel Stevens being given serious consideration, as he is well and very favorably known throughout the State, and is recognized as one of the best construction and maintenance engineers in New Jersey. This is Frederic A. Reimer, County Engineer of Essex County, and it is generally conceded by road authorities that he would be a most desirable man to have in charge of the road work, of which there will be a great deal for several years to come, owing to the fact that the Egan Road Bill, provided for the expenditure of $7,000,000 on a designated trunk highway system throughout the State, was favorably voted upon by the voters at large during the recent election.



FREDERIC A. REIMER
County Engineer of Essev Co., Newark, New Jersey, who is named for Commissioner of Public Roads of New Jersey

Mr. Reimer was born at East Orange, New Jersey, in 1874, and has spent his entire life in his native State. He was educated in the public schools of East Orange and took up engineering at the early age of seventeen, when he entered the engineering offices of H. V. Reimer, who was a well-known and prominent civil engineer. Four years later Mr. Reimer was appointed assistant city engineer of East Orange, and in 1909 was appointed city engineer in charge of all engineering work of that city. His work consisted of the construction of Telford macadam roads, bituminous concrete roads, asphalt block roads and the designing and entire supervision of the construction of the main drainage system and the extension of the sewerage system of East Orange. This work stands to-day as a monument emblematic of his ability.

Three years later, as the direct result of the work he had done in East Orange, he was offered the appointment of assistant county engineer, which he accepted, as it provided a wider scope for his engineering ability, and a large amount of work was planned for Essex County, of which Newark is the county seat. Then a year later he was offered and accepted the appointment of county engineer as successor to James Owen, who had served continuously in that capacity since 1868. All of these appointments had been made without practically any opposition, which vouched for his popularity, the latter occasioned by his ability evidenced by the excellent work and the improvements he had made as engineer in charge. After finishing out the unexpired term of Mr. Owen, Mr. Reimer was re-appointed county engineer in 1914 for the full term of five years, and has accomplished wonders in the construction of a county highway system.

Mr. Reimer is a member of the American Society of Civil Engineers, the American Society of Municipal Improvements, the American Road Builders' Association, the American Highway Association, the County Engineers' Association of New Jersey, and the New Jersey Sanitary Association, and is on important committees of all the above named engineering societies. He has been chairman of the Legislative Committee of the County Engineers' Association of New Jersey for the past two years.

He has been a life-long Republican and for years has been prominently identified with Republican politics in Essex County and in the State of New Jersey. He is also prominently identified with civic organizations and civic affairs of Essex County.

Mr. Reimer has paid a great deal of attention to road construction, maintenance and repair, not only in his own county, but throughout New Jersey and adjoining States, and has, without any doubt whatever, built up one of the finest organizations and units for road construction and maintenance to be found in this country. This road system of Essex County is silent evidence of not only his engineering ability, but of his executive ability as well. A history and synopsis of his road work and accomplishments will be of general interest. The writer has for several years been thoroughly familiar with this work, and has, time after time, driven over practically every road in the county.

In 1868, there was created by an Act of the Legislature of New Jersey, a Commission known as the Essex County Road Board. This Board was empowered to lay out and construct certain roads within the limits of Essex County, and this body laid out with much foresight the roads that are to-day the main arteries leading out from Newark to the surrounding county-seats and which, as the principal highways, receive the bulk of the traffic. But when these roads were constructed, a Telford macadam pavement was laid which was entirely adequate at that time, but which, as the years went by and traffic increased rapidly and the automobile came into general use, required constant resurfacing and costly repairs. A vast amount of money was thus spent each year in this manner, and one of the first recommendations that was made by Mr. Reimer when he became county engineer was for the reconstruction of these main traveled roads with high types of modern pavements. The proposal for the reconstruction of these highways received hearty support and full co-operation from the daily press, the State Road Commission, the officials in charge of the county road work and the general public which used the highways. Since that time the improvement of these main highways has been advanced each year, together with a large number of important connecting links, so that, at the present time the county has a most comprehensive system of so-called permanently improved highways, all of which have been built under the direct supervision of Mr. Reimer.

Another important step that he took several years ago by Mr. Reimer for the proper maintenance of the county roads was his installation of the patrol system of maintenance, modeled to a great extent after the well-known railroad method of maintenance of way. This system, as installed, has proven its worth many times since it was adopted in 1913, and the county has at work constantly throughout the entire year a force of about fifty-five patrolmen. Each of these patrolmen is supplied with a horse and maintenance cart and all the requisite materials for making immediate repairs, so that all ruts and depressions which make their appearance in the pavement, winter or summer, spring or fall, are given immediate repairs and the pavement replaced in the proper condition. Each of these patrolmen is given a specific section of road and he is required to patrol it once each day. The length of these sections depends upon the character of the road, the density and volume of traffic, drainage, grades, and other contingent engineering details.

In order to determine with the greatest possible accuracy the best type of pavement for any given road, and to avoid laying a type that is not considered suitable for the traffic conditions as found on that road, Mr. Reimer has compiled a very complete and extensive traffic census. This traffic census shows not only the number of vehicles passing over each particular road and the character of these vehicles, but it also shows the tonnage and the density of traffic as applied to various portions of the roadway surface.

Under his administration, there have been improved with modern high types of pavements the following roads, all of which are trunk lines and main traffic roads:

| | |
|---|---|
| Springfield Avenue with grouted granite block, Warrenite, National Pavement, and Roman Road at a total cost of | $ 210,000 |
| Central Avenue with Bitulithic, at a total cost of | 75,000 |
| Washington Avenue with Bitulithic, granite block, and asphalt block at a total cost of | 170,000 |
| Wyoming Avenue with asphalt block at a total cost of | 65,000 |
| Lyons Avenue with Bitulithic at a total cost of | 80,000 |
| South Orange Ave. with asphalt block at a total cost of | 135,000 |
| Broad Street, Bloomfield, with Warrenite, at a cost of | 150,000 |
| The Valley Road with Warrenite, at a total cost of | 180,000 |
| Pompton Turnpike with Warrenite, at a total cost of | 110,000 |
| Morris Turnpike with Warrenite and Durax, total cost | 45,000 |
| Bloomfield Ave. with grouted granite block, total cost | 190,000 |
| Myrtle Ave. with bituminous concrete at a total cost of | 30,000 |
| Total paving | $1,440,000 |

All of the above roads were constructed under the most modern and approved specifications, and they were all laid on well-built concrete bases.

He has also had charge of much important bridge construction and reconstruction, one of these contracts being for the reconstruction of the bridge over the Passai River at Belleville, the old structure having been replaced with a modern Strauss Bascule Bridge, the contract price for which was $225,000. This bridge was constructed jointly by Essex, Hudson, and Bergen counties. Prior to succeeding to the office of County Engineer, Mr. Reimer had made a study of the conditions at the propsed site of the new bridge and decided that the bascule type bridge more nearly suited the conditions, owing to the narrowness of the Passaic River at this point, and on account of the tides, than would the swing type of bridge. The latter type bridge was favored by the county engineers of Hudson and Bergen counties, and by the former county engineer of Essex County. Notwithstanding this opposition. however, Mr. Reimer was able to prove to the satisfaction of the authorities in control of the project that the lift bridge was preferable to the swing type in this particular case at least, for the safety of river traffic, which is heavy, and from the standpoint of economy. Bids for the swing type of bridge were thereupon rejected and proposals received for the lift type. This bridge is now completed and has been in operation for over a year. It has proven to be all that was claimed for it by Mr. Reimer, and its design and operation is of great satisfaction to the county officials and to the traffic using it.

There was also constructed a steel-girder I beam bridge encased in concrete on Bloomfield Avenue over the Passaic River at Pinebrook. The bridge is 225 feet in length with a thirty-nine-foot roadway, and the total cost was approximately $50,000. In addition to these two large structures, there have been built or reconstructed during the past three years about 150 smaller bridges, all of modern design.

Last year, pursuant to a recommendation that was made by Mr. Reimer, the County Committee on Roads advertised for bids for the furnishing of bituminous concrete surfacing materials, such as Warrenite, Amiesite, Topeko, and Type "R." This latter is a mixture made under specifications prepared by Mr. Reimer. This material is furnished by the contractors on the road by the ton. The material is then laid by the forces of the county by day's pay, a method that, in Essex County, has proven very successful and economical, and the roads that were constructed in this manner withstood the hard winter of 1915-16 in such a manner as proved the value of this method of procedure. In 1915, about eighteen miles of road were built by this method.

Each year for some years past the county has spent in the neighborhood of $60,000 for a non-asphaltic oil, used merely as a dust allayer, and has applied this material twice a year. Mr. Reimer, since he assumed office, has been rapidly dispensing with this treatment, and has had substituted in its place a liquid asphalt which has demonstrated that it not only allays the dust, but that it also preserves the road.

During his present term, Mr. Reimer has re-organized the engineering forces of the county, dividing the work and the responsibility so that at the present time his department has been brought up to a high degree of efficiency. At the time of his assuming control of the office, the lack of up-to-date maps and records and of an index to the old minutes and records dating back to the time of the creation of the office in 1868 was evident on every occasion when recourse to such records was necessary. At the present time, under the new system, an index to every record, document, and map in the office is available, making it but a matter of a moment to secure all information on a given project or improvement as to the action taken by the Committee or its predecessor, the Essex County Road Board, since 1868 up to the present time. All of the maps have been brought up-to-date and are being kept in that shape. A complete map of the county highway system has been published, a resurvey of all of the old roads has been instituted, and each bridge, culvert, drain, and pipe has been mapped and indexed on standardized sheets. The bookkeeping system of the office has been so revolutionized so that at the present time it is possible to find the cost of any road in the county on any day, and the total cost on each road, either by patrol sections or for the total length of the road.

All maps are drawn on standardized sheets and are filed in upright compartments without rolling. They are properly indexed and cross-indexed as they are placed in these files.

A modern testing laboratory has been installed, and there all materials, such as rock, oils, asphalts, cements, etc., used in the construction work that is done under contract are regularly tested, as are also the materials that are purchased direct for use by the maintenance forces and on force account construction. Complete reports on all of these materials are made regularly before the materials are used.

A system of inspection by which all roads under contract are regularly inspected by competent authorities at frequent and regular intervals, although without knowledge by the contractor as to the actual time when the inspection will be made. Reports are then made to the county engineer on the progress that is being made on the work, the kind of work that is being done, and all other information that will assist in getting the best possible kind of work from the contractors. It is worthy of mention that the contractors themselves approve of this inspection system, as it has eliminated the contractor who wanted to "skin" the job instead of building the best possible road with the best materials in the right way. The result is that the contractors who do work in Essex County are all of the right kind to-day, receive legitimate prices for their work, and use their best effort to construct roads that will last for the longest possible time for the type constructed.

A daily report system for the patrolmen has been inaugurated, this showing the work done each day, the materials used and the cost of the work. There is also an up-to-date method of keeping field notes so that they are really useful and immediately available for future use at any time without pouring through a lot of notes that have no bearing on the particular section desired.

In the next issue of Better Roads and Streets will be published a descriptive illustrated article on the road system, its construction, repair and maintenance as conducted in Essex County, New Jersey, by Mr. Reimer.

* * *

## American Road Builders' Ass'n Holds Meeting

THE annual meeting of the American Road Builders' Association, held on the afternoon of November 3, at the Automobile Club of America, New York City, was one of the best attended and most successful meetings ever held by this well-known organization. Just prior to the business meeting was the regular meeting of the Board of Directors.

The Association meeting was presided over by Colonel E. A. Stevens, State Commissioner of Public Roads of New Jersey, and President of the Association. Routine business was transacted and the annual election of officers held, the result of the latter being made that evening during the annual dinner.

The report of Secretary E. L. Powers showed the organization to be in excellent condition, as did also the report of the treasurer and that of the Executive Committee. The report of the latter committee was of particular interest in view of the fact that it gave a rather complete outline of the plans for the coming road congress, which will be held at Boston, Massachusetts, throughout the entire week of February 5. In conjunction with this road congress will also be held the Eighth National Good Roads Show. This show, according to the reports that have been submitted by the Executive Committee, will prove a still greater success than did the one held at Pittsburgh last February, which was the most successful exhibit of road building machinery and equipment and road materials that has ever been held in this country.

The evening was devoted to the annual Get-Together Dinner of the Association, which was also held in the magnificent

club house of the Automobile Club of America. There were about one hundred and twenty-five members and guests present, and the dinner was an excellent one. Following the dinner, the announcement of the result of the election of officers was made, and was as follows:

*President*—Arthur W. Dean, Chief Engineer of the Massachusetts State Highway Commission, Boston, Massachusetts.

*First Vice-President*—William H. Connell, Chief of the Bureau of Highways and Street Cleaning, Philadelphia, Pennsylvania.

*Second Vice-President*—Austin B. Fletcher, State Highway Engineer of California, Sacramento, California.

*Third Vice-President*—Arthur H. Blanchard, Professor of Highway Engineering, Columbia University, New York City.

*Secretary*—E. L. Powers, 150 Nassau Street, New York City.

*Treasurer*—Walter W. Crosby, Consulting Engineer, Baltimore, Maryland.

*Directors for Three Years*—T. R. Agg, Professor of Highway Engineering, Iowa State College, Ames, Iowa; W. E. Atkinson, State Highway Engineer of Louisiana; Fred E. Ellis, Manager, Essex Trap Rock & Construction Co., Peabody, Massachusetts; R. H. Gillespie, Chief Engineer of Highways and Sewers, Borough of the Bronx, New York City; B. Michaud, Deputy Minister, Department of Roads, Province of Quebec, Canada; Paul D. Sargent, Chief Engineer of the Maine State Highway Commission.

Colonel Stevens acted as toastmaster of the evening, and after a brief talk introduced Commissioner Edwin Duffey, of New York State, who was greeted with an ovation. Commissioner Duffey spoke of the recent campaign in his State and then took up the question of Federal Aid, stating that his State has not yet accepted or indicated acceptance of the offer of Federal Aid not because it was not wanted, but because the legislature is not in session, and no steps can be taken, under the laws of New York, until the legislature convenes, which will be shortly after the first of the new year. He also stated that it will be impossible for his department to use any of the second fifty million dollars raised for road improvement by the bond issue because this has all been allotted by the State, but that there is no question that the $4,000,000 necessary to match an equal amount to be provided by the Government through other and new sources, as the Department is strongly in favor of the acceptance of Federal Aid. This money, it was explained, is wanted to fill in a number of very important gaps on main through or trunk lines which have not been provided for in the allotment of the second fifty million dollar bond issue, and which otherwise would have to remain unimproved. His department is at present at work on a map showing the more important of these gaps and how they could be filled in by the use of the Federal Aid appropriation, and a table that will accompany this map will show approximate cost of construction of these gaps.

Commissioner Duffey also took up the question of co-operation between States on through inter-State routes, stating that his State is anxious to work with all States which adjoin, so that through improved routes can be completed. Arrangements have already been completed, he stated, with Massachusetts, Connecticut, and Pennsylvania for some of these routes, which is going to be extended to other routes as rapidly as possible.

Nelson P. Lewis, Chief Engineer of the Board of Estimate and Apportionment of New York City was the next speaker, and delivered a most interesting address, an abstract of which will be found on another page of this issue of Better Roads and Streets. Traffic on our roads was taken up in considerable detail, as well as that of England. It was shown that in New York State the automobile registration for three months of 1916 was fourteen per cent. greater than the total registration for 1915, which in itself is evidence of the tremendous increase in the use of our country highways.

Alfred Reeves, General Manager of the National Automobile Chamber of Commerce was next on the program, and laid particular stress on the inadequate salaries that are paid to highway engineers generally all over the country, stating that steps should be taken by every State to increase such salaries so that they will be in keeping with the work that is performed and the responsibilities that go with the various offices. He also took occasion to deplore the mixing up of politics with country highway and city street work, and recommended that every effort be made to separate street and highway departments absolutely from politics. He stated that the manufacturers of automobile and motor trucks generally are anxious to co-operate with the highway departments all over the country, and stand ready to help bring about reasonable restrictions which will help save the roads from destruction. This is a serious proposition, it was admitted, in view of the fact that there were no fewer than 1,500,000 automobiles manufactured and sold this year.

Maximilian Groten, mechanical engineer of the Imperial Russian Railways, Petrograd, Russia, in a brief address spoke of the small mileage of highways in his country, and the general lack of facilities for transportation by this method, as there are only about 40,000 miles of highway throughout the entire Russian Empire. This is one of the reasons that Russia has had, throughout the present war, so much difficulty in transporting men and munitions to the fighting fronts, and one of the principal reasons that the growth of the Empire has been retarded. Much credit was given to American highway engineers who have done excellent work there, and to American capitalists who have assisted materially in the development of transportation facilities of the rich Russian Empire.

Short addresses were also made by H. E. Breed, First Deputy of the New York State Commission of Highways; by Colonel E. A. Stevens, retiring president; by Frank Q. Brown, Chairman of the Good Roads Committee of the Automobile Club of America, and by Arthur W. Dean, the President-elect of the American Road Builders' Association.

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## The Fundamental Necessities in the Maintenance and Upkeep of Streets and Roads*

### By Will P. Blair, Secretary of the National Paving Brick Manufacturers Association

THE whole problem of streets needs to be viewed and dealt with with the same systematic business management that is applied to-day in the management and business of any and every private institution which has for its ultimate object progress or profit.

It is not enough in these days to know that the price paid for any particular thing is the net amount of money to be neither taken from nor added to as it is transferred from the buyer to the purchaser. Various methods are published from time to time that involve a so-called cost accounting in public affairs. Every cent is watched with exacting care from the moment that it is paid into the treasury of the city, while it lies in the cash box, its entry on the pay roll, its delivery to the contractor, or the person that performs the labor or furnishes the material. If one cent is missing, if the account does not balance, prosecution, disgrace, and punishment follows, the moment it is discovered that a cent has disappeared.

There is no objection to this oversight. No objection to the strict accountability or to the punishment that follows default or delinquency, be it dollars or cents.

But consider for one moment the ordeal through which a road or street has to pass in every detail which contributes to its worth, the condition of the thing bought as it is delivered into your hands. Who certifies to its quality? Who records its identification? Who is held responsible even for its existence? And where of record is there any competent evidence of any official character establishing the fact that every detail of the specification has been complied with or that everything of the smallest worth has been furnished.

An executor or administrator making purchase with the dead man's money has not only to swear as to amount of cash expended, but must swear to what he got and why the purchase was made in detail.

It serves no purpose to watch a dollar go and know that it is gone—merely to know—that it is gone. The business of the transaction is to know what comes to take the place of the dollar.

Upon receipt of a new purchase for a private corporation, the most competent, the best informed, the man whose word bears the largest degree of confidence to the company in his certificate, is called upon to report whether or not the thing

*Prepared for the Annual Convention of the American Society of Municipal Improvements, Newark, N. J., 1916.

purchased meets the requirements and is in truth and in fact value received for the money about to be paid.

The value of a street or road for the money about to be paid is passed upon, in ninety-nine cases out of one hundred, by an agency and manner least competent to judge and that too without any certificate even for the worthless judgment, and much less is there any bonding force of accountability by which loss, by fraud or ignorance, can in any way be recovered.

Frequently it is a pensioner standing in the inspector's shoes, but ofttimes even worse, a blind inspection by a dignified city council or committee of that body, after the street is finished—there is no way of seeing any defect that should have been known before hidden underneath the surface—undertakes to pass upon and accept the job.

Nor does it compass the case by establishing a guard over the thing received, as over the cash box, no more than it will suffice in merely knowing what is to be paid in cash.

A street is subject to every day use; as much as any machine in a manufacturing establishment; as much so as the vehicle that travels over it.

State highway departments, collegiate institutions, and even the office of Public Roads of the United States, have deemed it advisable to construct various types of roads, and roads of like type, of somewhat different construction, with a view to study, recording data, watching behavior, keeping a correct cost, maintenance and repair charge, comparing wear and tear in an endeavor to reach some conclusion and gather some testimony as to the worth and value of such roads respectively. This endeavor on the part of these organizations is perhaps an effort as nearly practical as possible under existing circumstances. Still, in every effort of this sort, one's conclusions are drawn but from one character of travel. It is necessarily alike over the various sections. No law of averages can be applied. The conclusions reached after years of study are of doubtful character at best. The conclusions are reached from conditions that are widely different from those actually existing on our streets as a whole. The effort itself, largely artificial, does suggest, however, that no actual condition has been put to any practical purpose from which correct conclusions may be reached. And it does strongly suggest that the information sought is of great necessity. Why build a road for study Why not study the roads built for use?

Counting traffic that passes over a street of any particular kind is no basis upon which to exercise judgment in any direction, unless that information is considered along with the knowledge of exactly what that traffic passes over. A mere name does not answer. A brick street, a stone street, an asphalt street, is meaningless for this purpose. A frame building can be built so that it will crush under the weight of a few tons, or built to sustain the weight of hundreds of tons.

Why cannot information of this character be obtained in a more practical and scientific manner and the information itself afford greater reliability and more adequately meet the necessities of the case?

There is no plan of street and road management or street administration that can be called fundamentally efficient, for the reason that no plan of management exists that includes in the plan a certified copy of construction, maintenance and repair, cost and identification, or any of the information sought by the building of these so-called experimental roads.

Streets which are improved are of various types.

They are in various states of repair.

They are of various locations.

Even a single street receives a variety of travel.

Single streets are often of such location that sections receive more or less travel.

The streets overlie varied conditions of soil.

Some streets are susceptible of easy natural drainage.

Other streets must receive artificial drainage.

They are generally built with the plan, specification and contract in the office of the contractor, with a foreman in charge of work who has never seen either.

The choice, the character, the type, the cost of all are subject to a greater or less extent *to the whim, the notion,* to the cheapness of cost, *influences of zealous promoters,* sometimes secured by one neighbor selling out another—in almost every case chosen from any consideration other than the ones upon which good sound judgment *should be exercised*—these streets representing one great mass of unknown conditions, evidence simply a lavish expenditure of money known to us as the streets of *this city* or *that*—roads of this county or that.

But few of these streets and roads have a legal name, most of them bear merely a nickname. None of them bear any identification whatever or relation ship to commercial accounting, such as is found in every well regulated commercial establishment.

The original investment as to its parts or its whole is not of record—at least not charged for further purpose; cost of upkeep is so confused with general charges against the whole lot that no knowledge whatever is obtainable as to the amount expended on any street or road, and we do not even know the actual reason for the expenditure, whether it was on account of repair due to wear and tear, on account of some defect of original construction, on account of accident, on account of some cut and opening, nor does any record disclose whether the street or road has remained out of repair or whether repair was needed, or whether the street or road has cost in repair an amount exceeding any justification for maintaining a road wholly inadequate for the travel and traffic that passes over it.

This chaotic and inexcusable street and road mismanagement has been allowed existence because streets and roads are sustained by donation in some one form or another, their earning capacity is not held to account. It has been allowed existence because of an existing lack of system that has become a habit, or may I suggest because up to this time this society has not yet taken on courage sufficient to wipe it out? In a commercial establishment, if a like manner and method of conducting was permitted, the institution would soon fall into bankruptcy. A department, a machine under such loose methods would continue in operation at a loss and escape detection. No information as to the value, the worth and economy of any tool or apparatus would be possible upon which improvements could be suggested and undertaken.

I am attacking no one person or persons. I am attacking the system, rather a condition without a system, which might be characterized as a childish comedy, were it not for the fact that the play becomes a financial tragedy.

What's the matter with the streets of your city? Some are lacking in design and specification, in which case they are for the most part the old time result of "just improve the street." Covering a period of twenty years past, the streets have been improved practically without supervision—without accountability for result—with a chaotic hit and miss—no two contractors building the same design alike, but with an "I know better how to build a street than anybody"—each following his individual method. With a careful exclusion of the necessaries of the specification—the result is that ninety per cent. of the defects found in streets are not due to ordinary wear and tear, but due to something else. If it is a brick or stone block street, a failure to compress the sand cushion—to make a smooth base—to wet the sides and edges of the brick—to fail to completely fill the joints with a cement filler—sins of omission. To roll the surface when the cushion is wet—to drive over and tear up the subgrade—sins of commission. On file in the city office there is no sworn record that this or that has been done or not done. The surprise is that we have so many good streets, not that we have so many poor ones.

Who in the town knows of a satisfactory street and why?

Who in the town knows of a street condemned and why?

Who knows why a street is out of repair and why?

Who knows why any street costs so much to keep it in repair and why?

Who knows how many dollars worth of labor any foreman uses in a day and how many dollars worth of work he delivers to the town therefor?

Who knows how much any street has cost for cleaning? Why so much or so little?

Would you buy a wagon with one spoke gone?

Would you buy an automobile with the differential left out?

Have I spoken too strongly? Let's apply the test. You may be operating a large business on your own account. You are about to expend $187,000 in improving a certain department. Would you shut up in your office the only two or three competent men you have and send out to oversee the expenditure some of your most incompetent men who would be scarcely able to read the blue-prints, much less understand them or have any capacity whatever for reasoning from cause to effect?

What business plan is there, therefore, of street and road management that could be put into operation which would serve immediate and emergency needs; which will furnish such accurate information as to original cost, cost of operation and service, usually designated as maintenance and repair, the application of such supervisory oversight as that when a break occurs it could at once be determined whether or not it was due to wear or tear or an original defect in some part? Dealing systematically with cuts and openings and replacements to effectually regulate, to the greatest advantage of the street, that annoying privilege, place upon the records of the city the street as it is and keep that record up-to-date. To get the information from a policeman is folly, to get it by way of complaint from the citizen is an outrage.

A business system must be established that is fundamental, which will bear upon everything which will secure for us an economical expenditure of money, a street best serving its purpose, removing the causes of compaint and the things complained of.

Separate these streets in certain divisions, and these divisions into sections, of in no case exceeding one mile in length. These sections must be measured, numbered, and recorded for the purpose of complete identification. To illustrate: East Forty-fifth Street, division Number 9, Section 17, beginning at the north property line of Superior and ending with the south property line of St. Clair, including intersections therein, 4,800 feet in length. Put such divisions in charge of a competent engineer.

You can then treat that particular section of street as a thing, a piece, as a machine; record its efficiency, watch its weakness, its strength, its value and its behavior; record information of every kind and character. Similar information can be gathered in like manner from every street within the corporate limits of the city. With the information in hand, which is possible to gather under such plan, the adaptation of streets of type and kind for the varied services in a short time will become apparent not only to the student applying a refined study to the situation, but to the layman as well.

I have not gone into details required to put the plan suggested into working effect, that is an easy matter. Manufacturing and other business institutions find it no difficulty. Disposition to do will remove all obstacles.

By such a plan of road and street management, the greatest possible economy would at once become apparent by the ability to trace the actual dollar to the thing purchased for the particular road. Aside from this benefit, data, experience and comparison would become available for future judgment. Street and road improvements, maintenance and repair would at once become a scientific, systematic, business-like operation and wasted millions would be saved.

* * *

## Asphalt Plants for Country Roads and Streets

(*Continued from page* 6)

3.—The design of the plant is such that no jacks are required to support it nor to absorb vibration. There is no danger of the plant turning over, as all parts are set as low as possible and an ample factor of safety is provided.

4.—The hinged bin and elevator admit of the plant being shipped without dismantling, and makes it possible to have the plant in running order within an hour after it has been unloaded from the freight car.

5.—The large diameter wheels offer the least resistance to tractive effort, and their wide faces adapt them to soft roadways. In Florida, where unusually soft ground has been encountered, the wheels are constructed with still wider faces.

6.—The large fire box adapts the dryer to any kind of fuel. Oil burners may be applied with excellent results where the price of fuel oil is not prohibitive.

7.—The sand drum is entirely within a housing, and is entirely surrounded, inside and outside, with the hot gases.

8.—The proportioning of the various ingredients is done after the moisture is driven off, so that the final weights of the batches are independent of the moisture content of the aggregate before drying.

9.—All bearings are babbitted and split, facilitating repairs and adjustments without it being necessary to secure expert machinists or shop service. The shaft journals may be rebabbitted many times before a new shaft is required. A wornout bronze bushing means a wornout shaft.

10.—The mixer, dryer, and each elevator has independent chain and sprocket drive from the jack shafts, so that no two elements are in direct geared connection. An accident to the mixer does not affect the dryer or elevators. A broken chain is simpler than stripped gear teeth and twisted shafts.

11.—The plant is manufactured in the shops of the Hetherington & Berner Company, which plant includes steel shop, foundry, forge shop, machine shop, and pattern shop. The plants are designed, built, and sold by the one concern, the manufacturer, in one location and in one business.

* * *

## Legislation Proposed for Motor Trucks

(*Continued from page* 12)

material really penetrates into the metal and does not lie as a blanket on top, for a great many penetration roads are not properly built. The speaker stated that he does not personally favor the penetration type of pavement for trunk highways on which the traffic of heavy motor trucks and heavy horse-drawn vehicles is large.

The bituminous concrete, or mixed method was then described, including Warrenite and Bitulithic, which are the highest types of this kind of pavement. A seal coat for the bituminous concrete pavement was advocated, and when this type of pavement is laid on a well-built concrete foundation, it makes an admirable pavement for trunk highways. Slides of the now famous pavement on Hillsdale Avenue, Queens, were shown. This is a bituminous concrete pavement carrying all classes of traffic, being a trunk highway out on Long Island, and the traffic census shows that the daily traffic runs between 2,000 and 5,000 vehicles per day. The pavement was laid more than four years ago, carried this traffic winter and summer, and there has been absolutely no maintenance to date.

Asphalt block, which for several years has been used quite generally on the main roads leading out of New York City, was next taken up. This type of pavement, he said, is giving quite general satisfaction and has proven that it can withstand heavy motor truck, horse-drawn and automobile traffic.

Sheet asphalt, although used in some scattered sections of New York State on country highways, is not a type of pavement that is generally used on country roads, although it has given good satisfaction in the places where it has been used. It does, however, make an excellent pavement for city streets, and throughout practically all parts of the East is fast replacing vitrified brick as a street surfacing material.

In speaking of Portland cement concrete as a paving material, Professor Blanchard stated that its status has not yet been sufficiently decided, but that it has proven to be an excellent type of pavement under certain traffic conditions. It must be properly maintained, however, and cracks taken care of and filled soon after they appear. It has the distinct advantage of making an excellent base for other types of pavement after the maintenance charges become too high.

Brick has for many years been a popular type of pavement, but its use has so declined in the East that in many cities it is hard to find a brick pavement. A series of slides showed the various kinds of failures of brick pavements that are generally to be noted, and the causes of most of these failures were explained. The new forms of construction now being advocated by the National Paving Brick Manufacturers' Association were taken up and described.

Wood block is seldom used on country highways, although it is frequently used in New York State to carry a trunk line through a city or village, and very generally on bridge floors throughout the State.

Stone block and Durax, both of which are only used within cities, were the last of the types described and illustrated. Professor Blanchard closed his talk with slides showing the stone wheelways used in foreign countries, and the methods employed in measuring the wear on pavements in England.

State Highway Commissioner Edwin Duffey was the next speaker, and when introduced it was announced that he had come to the meeting to speak as an individual and not as the chairman of the commission which is revising the licenses and regulations, and that his talk would be entirely informal. He stated, however, that a formal and open meeting would be held the following week at Albany, and that he would like all to attend, at which time they would all be given an opportunity to place any grievances before the entire commission.

Commissioner Duffey explained the very large problem which New York State is up against in the construction of her highway system, stating that during the past few years it has been found, owing to the increased use of the motor truck and the automobile, that entirely new elements have been encountered. It was explained that New York State will soon have a really wonderful system of highways, and that it is the hope of the Commission of Highways to use the Federal Aid money, which will amount to about $4,000,000 in the next five years, and which will be matched with at least an equal amount, making a total of $8,000,000 for the construction of gaps in the State system for which no appropriations have been made out of the $100,000,000 bond issues, all of which are on trunk lines. It was explained that the legislature makes the apportionment for the different routes, and that as this has been done, these most important gaps would have to remain unbuilt. These gaps include such important highways as the main routes along Lake Erie in western New York, this being the gateway to and from the western States.

The last issue of $50,000,000 for highway work in New York State was apportioned $20,000,000 for State highways, which are the trunk lines, and $30,000,000 for the county systems being built with State-aid. Much co-operation has been given by the counties, Commissioner Duffey said, and many of them are helping out on through routes and main feeders for trunk lines by changing their systems so that they work right into the proposed State system. As has been stated, this division is made by law, and apportionments are made to the individual counties, so that it is impossible for the arrangement or the amounts to be changed so that really important routes can be built in the larger and richer counties by using money that has been apportioned to poor counties which are not in position to take up the State allotment.

Commissioner Duffey agreed with statements made by Professor Blanchard that in the past costly and expensive wide pavements had been built through cities and villages, but stated that this has now all been changed by the present laws, and that the method used now is to build, where it is necessary through a town or village in order to continue a through route over an uninterrupted improved road, but that the State would not, in any case, build a road of a higher or more expensive type through the village than it had built over the country highway to the corporation limits of such a village or town. Any extra width of street above the standard width of country road which the State is building to the corporate limits, or any more expensive type of paving must be paid for by the corporation itself.

Commissioner Duffey then gave a brief history of the special commission appointed by the Governor to study and report upon the licensing and regulation of motor trucks which are, in every part of the State, tearing the roads to pieces under the heavy loads hauled at high speeds, and for which use of the highways motor trucks and motor busses now pay only five dollars per year.

This commission, which is to report to the Governor on or before January 1, 1917, has already gathered a vast amount of valuable information and data from all States in the United States which have laws and regulations relating to the use of motor trucks, and from several foreign countries. Information has also been received from many States showing what they hope and expect to do toward the regulation of these vehicles, although none of them will take any final action until after action has been taken by New York State and New Jersey. Commissioner Duffey urgently asked truck manufacturers, owners and users to attend the meeting in Albany a week later, and also the meeting which will be held at a future date in New York City, and to present their views, as the Commission desires to take into the consideration of all sides of the question. There is no desire to have passed any legislation that is not fair and which could be taken as unjust to the motor truck, although it has come to the point where something must be done for the protection and preservation of the highways, or they will be in a deplorable condition in a short time, and New York will be going through just what New Jersey is at the present time, as the increase in automobile and motor truck traffic has "literally shot to pieces the fine road system of New Jersey," which has for many years been famous for her fine roads.

It was pointed out by the Commissioner that New York State will, when the system is completed, have about nine thousand miles of high-class roads which will have cost the people of the State something around $160,000,000, and that the various counties have built and will have completed by the time the State system is completed, approximately 11,500 miles more, at a cost of another $100,000,000, so that the improved road system of New York State will comprise over $260,000,000 in money expended and a mileage of more than 20,000 miles of really improved and hard surfaced roads.

Many of the roads that have been completed were built before truck and omnibus traffic leaped to where it is to-day, and these roads must be protected. Otherwise they are soon going to pieces and will represent a total loss to the people and to the State. The counties all over the State want improved roads, and they want mileage. They are generally opposed to putting the bulk of the funds available into a few miles of the most expensive types of roads, but want this mileage stretched out as much as possible. They do not, however, want roads that will go to pieces in a year or two and prove a dead loss. They have seen enough of this sort of thing in the past.

The concrete road is being favored all over the State, and it is rapidly growing in popularity. The people of New York State report to the Highway Commission that they do not care about a few cracks, as they ride on the road and not on the cracks. What they want is a road that is as good in all seasons of the year as the concrete road has proven itself to be, and which will not cost any more than that type has been costing. Commissioner Duffey stated that first-class concrete roads that are standing up well under heavy traffic are being built right along all over the State excepting in some isolated sections, at from $15,000 to $16,000 per mile, sixteen feet in width, while the macadam road costs from $10,000 to $12,000 and the brick block and asphalt block road costs from $26,000 to $28,000. The people see that the concrete road is giving excellent satisfaction, and they know that its life will easily be from ten to twelve years. They also know that after that time, there is still an excellent foundation for some other type of pavement which may be laid on as a resurfacing job. There is strong opposition in New York State, particularly "up-State" as the northern and western parts of the State are called, to permitting traffic and the vehicle to outrun the type of road which was designed and constructed to sustain the traffic and vehicle.

Commissioner Duffey stated, however, that traffic is now coming by leaps and bounds so that it hardly takes any time to wear out and ruin many of the roads that were designed and built for more moderate traffic, and that some provision must be made immediately to take care of such roads. Does not the road itself make possible the traffic and the vehicle? If the road were bad, heavy trucks would not be used over it. Traffic would also be light. Is it not right then that, after the road is once built, the traffic and the vehicle which destroys it should be called upon to pay at least a portion of the maintenance and repairs needed to keep the road open to traffic?

There are about seven hundred miles of concrete roads in New York State at the present time, which is about ten per cent. of the total improved State System mileage. These seven hundred miles have all been built by the State, but there is a considerable additional mileage of this type of road that has been built by the counties and other units. The Commissioner stated that it is his hope that by the time these concrete roads are worn out, a new and cheap, but really good type of road will have been discovered which can be placed on the concrete bases that will be left.

After the Commissioner had finished his talk, it was announced that he would unofficially, so far as possible, answer questions by the members of the Truck Club relating to the proposed legislation. These questions and answers were of such a nature, however, that the writer does not deem it advisable to antedate the report of the special commission, so they are omitted for the time being.

One interesting thing that was brought out, however, was the fact that a traffic census kept in New York State this year for a period of forty weeks, or practically the entire trucking season, showed that trucks within the State covered a total of 14,000,000 truck miles over the State roads, and that the enormous total of 60,000,000 ton miles was reached.

# Better Roads and Streets

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Did Old King Winter find you prepared?

* * *

What, all this discussion on preparedness been wasted?

* * *

Thank goodness, it is "Never too late to mend."

* * *

Preparedness when the bluebirds begin to whistle next May would be an excellent ambition, and besides it means a lot of money saved, too.

* * *

Now is the time to make a note of all those little things that need attention on your road rollers, mixers, pumping outfits, pipe lines, scarifiers, graders, etc., so you can repair or replace them this winter and have them fit for next season.

* * *

And, say, another thing you ought to do is provide a place to get all your machinery under cover. The rust of one winter is as hard on it as a season's work. And, then, the sight of expensive county road building outfits standing exposed to the rain and snow from December until May is a poor incentive for the average taxpayer to vote for bonds to purchase new machinery every year or two. Think it over.

* * *

Again, while speaking about preparedness, it's time you fellows, who have the building of new city streets and country roads under your care, were beginning to plan that necessary legislation, decide what you intend to do, and most important of all determine the "type for the place." Be prepared to let your contracts early. That unfinished contract that is going to be an "eye-sore" and an inconvenience to your community all winter might have been completed in good time if you had started early enough on it. Don't blame the contractor, he has enough troubles besides shouldering the one labeled, "started too late."

* * *

December 5 and 6 are the dates set for the meeting of the Paving Brick Institute to be held at the Statler Hotel, Cleveland, Ohio. The arrangement of their program and speakers will be found in another column of this issue.

* * *

This is the time of the year that road machinery is being laid up for the winter in a great part of the United States. Much time, money, and inconvenience will be saved if it is not merely "laid up," however. Cover all working parts with a thick layer of grease and they will be found to be in excellent shape in the spring when they are wanted. This applies particularly to the steam and gasoline engine parts on road rollers, traction engines and on motor trucks. It is also well to thoroughly clean out the tubes of fire tube boilers, and to give the boilers themselves a general cleaning out. Then see that they are drained so that there is no danger from freezing. A little precaution at this time of the year will save a world of trouble three or four months from now, and will also be found to be very beneficial to the pocket book.

* * *

The Portland Cement Association, Chicago, is undertaking at the present time the compilation of what will be one of the most interesting and valuable histories of pavements of the concrete type in existence. Actual and comprehensive surveys and inspections of all known concrete pavements in the United States are being made, the object being to learn their condition and to secure data on what it has cost to maintain them, the methods of maintenance that have been used, and all other useful data. Local authorities where the pavements are located are also being consulted and steps will be taken to give advice regarding the best manner of taking care of any maintenance that may be necessary in the future. The findings of this survey and inspection will be so recorded by the Portland Cement Association that they will remain a permanent record and a real history of every known concrete country road and city street in the United States. This task, which is a prodigious one, is only made possible by the excellent organization and the complete system that has been worked out during the past year by Mr. J. P. Beck and his several able assistants.

* * *

Any contractor or municipality having need of a complete road building plant, consisting of concrete mixer, portable industrial railway, locomotives, industrial cars, bottom dump wagons, steam road roller, wheeled scrapers, gasoline contractor's water supply pump, steel curb forms, etc., can secure a bargain by communicating direct with the Contractors' & Mill Supply Company, 716 Ellicott Square Building, Buffalo, New York, which has the plant for sale. The entire outfit is in excellent condition, and was used last summer.

* * *

The thirty-eighth annual meeting of the Ohio Engineering Society will be held at Brown Hall, Ohio State University, Columbus, Ohio, January 31, February 1 and 2, 1917.

President Clyde T. Morris, Professor of Engineering at the Ohio State University, has charge of the program, and has the promise of many first-class papers. Mr. John Laylin, of Norwalk, Ohio, is secretary of the society.

* * *

The first annual Southwestern Concrete Show to be held in connection with the Annual Convention of the Southwestern Concrete Association is announced to be held at Kansas City, February 19-24, 1917. This show will follow the Tenth Annual Cement Show at Chicago at an interval of four days giving exhibitors ample time to move their exhibits from Chicago to Kansas City. A Good Roads Day has been arranged for and throughout the entire show a program of interest to users of cement for all purposes has been arranged for. Exhibition space in Convention Hall, Kansas City, and any information regarding the show can be had by writing to Chas. A. Stevenson, Chairman Concrete Show Committee, Southwestern Concrete Association, Kansas City, Missouri.

That the country will have three big cement shows in 1917 is now evident from the announcement of the Mid-West Cement Users Association that they will hold the Mid-West Cement Show at Omaha, Nebraska, on March 6 to 10. The arrangement of the dates of these shows is such as to permit exhibitors to attend each of them, ample time being given between the closing date of each preceding show to allow exhibitors to ship their exhibits to the show following.

* * *

The American Highway Association has compiled statistics showing some interesting distributions of the different essentials in road construction. These tabulations show that in the case of gravel roads, forty-one per cent. of the total cost goes into grading and drainage, and the remaining fifty-nine per cent. goes into surfacing, which includes labor and materials. In the case of a total of 104 waterbound macadam roads analyzed, thirty-seven per cent. of the total cost went into grading and drainage, while sixty-three per cent. was expended for materials and labor for the surface. In the case of fifty-three bituminous macadam roads, twenty-seven per cent. of the cost was expended for drainage and grading, while seventy-three per cent. was expended for materials and labor for the surface. The complete figures show that on the average of the roads investigated, more than one-half of the total cost of a surfaced roadway is spent for the materials and labor employed in surfacing the graded and drained right-of-way.

* * *

James Sheppard, of Queenstown, Ontario, Canada, the well-known superintendent of the Welland County Good Roads System, was killed by a train at Brookfield, Ontario. Mr. Sheppard was well known to road officials and road engineers throughout the Province of Ontario and also throughout the northern and eastern parts of the United States, and had done excellent work on the modern system of highways that was being built in his county. He had been in charge of this work since the beginning of the project for the construction of the system.

* * *

The announcement has been made by the Oregon State Highway Department that R. R. Clark has received from the Department the appointment of Supervising Engineer on the erection of steel work on all bridges in the State which come under the jurisdiction of the Highway Department. The appointment is an important one, as there will be a large number of bridges incident to the completion of the road system that is being constructed.

* * *

Frank A. Nikirk has been appointed temporary assistant city engineer of San Jose, California, succeeding J. W. Ford, who recently resigned. The position is one that is covered by civil service, and the permanent appointment will be made some time in the future following the regular examination.

* * *

Col. Malcolm H. Crump, F. R. S. A. Consulting Engineer and Geologist, Bowling Green, Kentucky, for the last four seasons County Road Engineer of Warren County, Kentucky, has resigned, effective January 1, 1917. His entire time will be devoted to natural asphaltic material for surfacing highways, together with oil and gas development and reports on same.

* * *

Announcement is just being made of the merger of the businesses of the Buffalo Steam Roller Company and the Kelley-Springfield Road Roller Company.

The new company will be known as the Buffalo-Springfield Roller Company. Its main factory will be located at Springfield, Ohio, with the home offices at the same place.

This consolidated company will constitute one of the largest concerns in the world engaged exclusively in the manufacture and sale of Road Rollers.

The line of manufacture will comprise rollers of all types for all purposes and in sizes varying from two and one-half tons to twenty tons, including the full line of Buffalo Pitts Rollers in both the tandem and macadam types, as well as the complete line of Kelley-Springfield Steam and Gasoline Rollers in both the tandem and macadam types.

The entire sales organization of this company will be taken over by the new company, and the present branch offices of the company located at Boston, New York, Philadelphia, Pittsburg, Chicago, and Portland, Oregon, will be continued as branches of the new company.

* * *

CONFERENCE ON ROAD ENGINEERING EDUCATION.

Five National Organizations to Discuss Highway Subjects to be Included in Civil Engineering Curricula of Universities and Colleges.

Plans have been perfected for a national conference to discuss the subject of highway engineering instruction in the civil engineering curricula of universities and colleges. The meeting is to be held December 29, at 8:30 p.m., in the assembly hall of the Automobile Club of America in New York.

It is under the joint auspices of the Society for the Promotion of Engineering Education, the American Association for the Advancement of Science, the National Automobile Chamber of Commerce, the Automobile Club of America and the National Highway Association.

Preparation of the program is actively under way, and the papers presented and the discussions upon them will be published in the Proceedings of the Society for the Promotion of Engineering Education.

Organization of the meeting is due to the ideas and efforts of Arthur H. Blanchard, C. E., Professor of Highway Engineering at Columbia University and Secretary of Section D, Engineering, of the American Association for the Advancement of Science. It is a public recognition of the growing need of more technically trained men in road construction, to which the attention of highway commissioners and of educational institutions throughout the country has been called by the National Automobile Chamber of Commerce.

* * *



**Hauling a German siege gun. These powerful guns were the surprise of the European war. The gun weighs over 30 tons. Practically every caterpillar in Europe has been confiscated for war use.**

* * *

The following letter written to Mr. James H. MacDonald of New Haven, Connecticut, by the New Jersey Civil Service Commission fully explains itself, and this resolution as passed by that Commission expresses the sentiment of BETTER ROADS AND STREETS and hundreds of his friends and admirers everywhere:

STATE OF NEW JERSEY
Civil Service Commission

Commissioners—George H. Burke, President Paterson; Edward H. Wright, Newark; Joseph S. Hoff, Princeton; Gardner Colby, Chief Examiner and Secretary; Thomas E. Mernin, Assistant Secretary; Theodore H. Smith, Jersey City, Trenton.

Mr. James H. MacDonald,
Chamber of Commerce Building,
New Haven, Connecticut.

Dear Mr. MacDonald: I take pleasure in advising you that the Civil Service Commission at its meeting held on Tuesday, October 10, passed the following resolution:

"*Resolved*: That this Commission express to Mr. James H. MacDonald its gratification on the able and efficient methods employed by him in the recent examination for Road Inspectors, and its belief that this examination and the one previously conducted by him have set a standard which will greatly aid in an efficient and thorough plan of road inspection in the State of New Jersey."

Yours very truly,
CIVIL SERVICE COMMISSION,
Per Gardner Colby,
Chief Examiner and Secretary.

* * *

HOW AN IOWA CITY OBTAINED GOOD ROADS.

It is not likely that more than a small percentage of the people of this country ever heard of Eagle Grove, an Iowa

City of about 4,500 population. Although small it is reached by several railways and is the marketing place of a flourishing rural district. Some of the enterprising citizens decided it ought to have still more trade, and that the best way to develop such trade was to improve the main roads leading into the country. So about eighteen months ago they organized a good roads committee, which raised over $10,000 in cash and secured promises of labor of equal value from farmers. A grader, scrapers, drags, and the necessary tools were bought and thirty-five miles of gravel roads were built. The really important fact is that the business men and farmers realized from the outset that building the roads was merely the first step necessary for good highway transportation. So they have organized a system of patrol maintenance for the new roads, the funds being furnished by the business men of the city. While it is true that road work ought to be under public officials, it is also true that well-managed road construction and maintenance at private expense is often of high educational value and prepares the way for proper public administration. It should not be forgotten, in this connection, that even in wealthy cities like New York and Chicago, such important work as good street cleaning was not well organized until merchant associations carried it on better than public departments had done and thus demonstrated its practicability and desirability.

* * *



* * *

The return from a good road also flows in part from its power to direct the development of the district traversed. If you doubt that road improvement quickens such growth, ask any real estate operators for their opinion, or observe that every advertisement of a farm for sale mentions its location on or near an improved road as an attraction.

* * *

There are excellent reasons for including the pleasure of using an improved road as part of the return on our investment. The people of the United States spent in 1915 $2,500,000,000 for spirituous and malt liquors, $800,000,000 for tobacco, $450,000,000 for the "movies," $300,000,000 for candy, $200,000,000 for soda water and $50,000,000 for chewing gum. The total for these pleasures is $4,300,000,000. So I think it conservative to say that the average man is willing to pay something for pleasure. There can be no question about the pleasure derived from riding on good roads, and that a part of the money invested in such roads can be logically justified on the score of this pleasure. After all, the total annual expenditure on roads in the United States is only equal to our purchase of candy and merely one-eighth of the money spent on liquor.

The Purington Paving Brick Company, of Galesburg, Illinois, has become a licensee of the Dunn Wire-Cut Lug Brick Company, of Conneaut, Ohio, and will engage extensively in the manufacture of wire-cut lug brick. The Purington Company is one of the biggest paving brick concerns in the United States, with a daily output capacity of about 350,000 bricks. The Purington organization consists of F. G. Matteson, presiden and treasurer; George C. Prussing, vice president; C. D. B. Howell, vice president; W. H. Terwilliger, secretary; W. G. D. Orr, general manager.

* * *

We are just in receipt of the October issue of "Tractor Farming," published by the International Harvester Company, which is filled with interesting news relative to their "Mogul Tractors." "Tractor Farming" is a twelve-page pamphlet, well edited and will be mailed to interested parties on receipt of a request to "The International Harvester Company, Harvester Building, Chicago, Illinois.

* * *

## Going in Debt for Good Roads

(*Continued from page* 25)

and the bonds so retired cease to be an interest charge on the county. Under the sinking fund plan none of the bonds are retired until the end of a definite period, and the entire sum raised bears interest during the entire life of the bond. The county, therefore, pays interest on the money so borrowed and in addition sets aside each year as a sinking fund, an amount sufficient to retire all of the bonds when they become due. The sinking fund is deposited with banks and bears some interest. This interest ordinarily is only three per cent., whereas the county has to pay from four to six per cent. to the bondholders. The serial plan is a much cheaper method of raising money for road improvement even where the sinking fund bears interest as high as four per cent.

The total cost of a $100,000 serial bond extending over a period of twenty years with interest bearing five per cent. will amount to $152,500, while the total cost of a sinking fund loan covering the same time and bearing the same rate of interest with a sinking fund bearing three per cent. interest and compounded annually will amount to $174,431 for each $100,000 of bonds issued. Certainly this saving is worth considering.

It is not always advisable, however, to begin paying off a bond issue the first year of the loan. Counties should so arrange their financial obligations as to make the burden comparatively light at the very outset, thus giving the people a chance to develop their resources through the improvement of the roads. To do this, the burden should be distributed so equitably over a period of years that it will avoid the two extremes of excessive tax levies on the one hand to pay off the debt too quickly and the extension on the other hand of the debt beyond the life of the utility, in order to obtain a low tax rate.

The most desirable type of bond, therefore, appears to be one in which the first payment is made the fifth or sixth year from the date of issue and the other payments distributed equally over a certain term of years, depending on the probable life of the improvement.

Let us assume that $100,000 of thirty-year five per cent. serial bonds are to be issued. If the first payment is deferred to the end of the sixth year and the other payments made in equal annual amounts during the remaining twenty-four years, the total outlay for interest and principal will amount to approximately $190,000. The total cost of a $100,000 sinking fund loan covering the same term and bearing the same rate of interest with sinking funds bearing three per cent. interest compounded annually, will amount to $203,500, thus showing a saving for the deferred serial bond of $13,500 for every $100,000 of bonds issued. By adopting the deferred serial bond instead of the sinking-fund plan the average county could save more than enough to pay all engineering and overhead expenses.

In this connection I wish to quote from an article published in The Annalist in October, 1915. This article was prepared by Mr. Alfred D. Chandler of New York. Mr. Chandler says:

"When it was revealed to the Finance Committee of the New York Constitutional Convention that for every $100,000,-



*Concrete Road between Stonington and Mystic, New London County, Conn. Length, four and one-half miles; width varies from sixteen to twenty feet. Built under the engineering supervision of the Connecticut State Highway Department.*

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000 of New York's standard fifty-year sinking-fund bonds at four per cent. the difference in interest between the sinking fund and the serial-bond method was the astounding sum of $98,000,000, while the difference in actual cost if the sinking fund earned the accepted five and one-half per cent., was $35,690,000, or even if it could earn six per cent. was $14,934,400, it brought that convention to an impressive realization of New York's past neglect on this score and of the needless expenses attached to its present outstanding bonded debt, State and municipal, of about $2,000,000,000, or about double the bonded debt of the United States."

The objection raised sometimes to serial bonds is that they do not bring as good a price on the bond market as the sinking-fund bond. Let me read to you what Mr. Chandler says on that subject:

"Some hesitation arose as to the receptivity of the New York market for serial bonds, all doubts of which happily were removed pending the sessions of the convention by the successful marketing (June 29, 1915), of New York City's first serial-bond loan for $24,000,000, at a higher price than was obtained or a simultaneous sinking-fund loan of $46,000,000."

In conclusion I wish to call your attention to another important point that should be considered when bonds are issued for road improvement. The life or term of bonds should be approximately the same as the duration of the improvement. It is a mistake to issue fifty-year bonds for roads which will not last ten years. In other words, the indebtedness should be liquidated at a rate at least equivalent to the depreciation of the improvement thus financed. Some of the States have laws fixing the term and character of the bonds that may be issued. So far as I know, New Jersey is the first and only State to limit the term of bonds to the probable usefulness of the improvement. The term of bonds in New Jersey is fixed by statute as follows: Stone, concrete, and iron bridges, thirty years; roads and streets built of concrete six inches thick, or of blocks of any material or of sheet asphalt laid on concrete foundation, twenty years; bituminous concrete construction, fifteen years; water-bound macadam or penetration process, ten years, and gravel, five years. The New Jersey law provides that all municipal bonds shall be paid in annual installments commencing not more than two years from their date of issue, in other words, deferred serial bonds. Other States would do well to follow New Jersey's lead in this matter. If they did, it would have the effect of standardizing the issuance of road bonds and would result in the saving to the taxpayer of many millions of dollars annually.

* * *

## The Passing and Conservation of Macadam City Streets and County Roads

(*Continued from page* 8)

5, 1916, page 82, under the title, "Drain! Drain! and Drain Some More," it seems sufficient to close by the following brief statements:

1. If the old macadam has not a depth of at least four inches of solid metal, it should be reinforced by a surfacing of new metal thoroughly compressed into the old. During construction test holes should be dug in the old macadam at intervals of say one hundred (100) feet. A mere "shell" of stone which looks fairly well when dry is not sufficient, but does provide a solid construction to build upon without the expense or waste of removal. In short, save what exists and build up on that. Contracts should always provide unit prices for new materials of the several grades possibly required for building up the old macadam in sections where such test holes show more metal is required.

2. Disturb the old macadam just as little as possible, by accommodating the new lines and grades to the old as far as practicable. For instance, if the crown is too high, correct this as far as possible by raising the sides and not by excavating from the center of the road.

3. If the old street or road is not properly drained, provide such drainage, which is a comparatively simple and inexpensive operation and important, whatever kind of pavement surface or foundation is adopted. These are matters theoretically appreciated by all, but practically neglected in far too many cases by both engineers and road builders.

# THE OHIO GOOD ROADS FEDERATION

## Ohio division of the National Highways Association

## PURPOSES!

"The Ohio Good Roads Federation is an agency created for the purpose of focusing the thoughts of the people upon the best plan for improving the public roads of Ohio."

"To disseminate knowledge and increase the interest relative to the ethical and economic value of our public roads."

"To aid all efforts for their improvement."

"To advocate wise, equitable and practical road legislation."

## SERVICE!

**To the Legislator - - - To the Road Official - - - To the Citizen**

TO THE LEGISLATOR---Our Legislative Committee is familiar with the road laws of other States in the Union and with those of Ohio for the past eight years. We are collating suggestions from many sources which will be submitted to the General Assembly at its next session. Get in touch with us, so that you may be "PREPARED" to discuss all phases of this great question intelligently.

TO THE ROAD OFFICIAL---The federation thru its bulletins, booklets and general service can be of wonderful help to you in your local work. Be friendly and let us help you solve some of your perplexing problems. We've been thru the mill in taxation, legislative procedure and administrative methods. We are ready to help you—it's up to you.

TO THE CITIZEN---A community is what its people make it. The more wide-awake and enterprising citizens there are in it the greater the community life and civic pride. Interest in the improvement of roads is the duty of every citizen. A community is known by the roads it keeps, the condition of its roads is its greatest advertisement—accordingly too many communities are poorly advertised. Well-kept highways represent the thrift and industry of the people and the efficiency of the local road officials; whereas, mud, ruts, bumps, weeds and brush represent the indifference of the officials and indicates an inactive, don't-care public sentiment.

**What is your community doing? Can we help you?**

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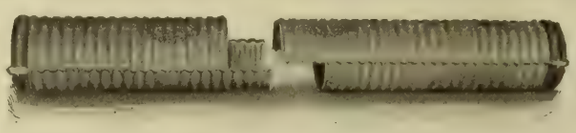
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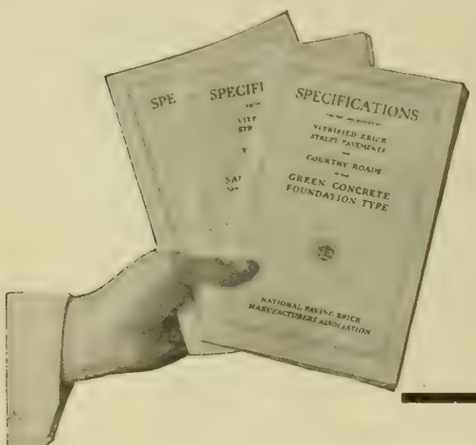
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## Problems and Methods in Snow Removal and Disposal

(*Continued from page* 15)

to secure additional teams and drivers after storms, which is the time we need them the most; and the additional cost would be considerable.

These outfits have been tried out on light dry snow, heavy wet snow, sleety or icy snow and snow packed by traffic, and under these different conditions they have given first rate service. At their rate of speed of nine to ten miles per hour with sweeper attachments they are able to secure good results with revolving brooms in places where horse-drawn sweepers will not operate properly. The speed of the latter is not sufficient to revolve the brooms fast enough to prevent the bristles becoming clogged with snow, in which condition they will not sweep the snow aside. This trouble is not experienced with the tractor brooms, as they revolve too rapidly to become clogged and consequently clean the walk or drive pretty thoroughly. With our three tractor outfits we have been able to keep a section of downtown drive one and one-eighth miles long practically clean and open for traffic during a snow falling at a rate not exceeding one inch per hour. It is our intention to add to our motor snow cleaning equipment year by year so as to gradually replace the horse-drawn plows.

As to the comparative cost of work done by tractor plows and by horse-drawn plows, carefully kept records show that we have been able to do snow cleaning with tractors at a cost considerably less than that of work done by horse-drawn machines. The tractor outfits are particularly valuable in breaking up packed snow and ice, and in plowing on the drives they can throw the snow in ridges several feet deep on top of the curb, leaving the gutters entirely free and open, which is a most desirable feature. Horsedrawn machines are able to plow only a part of the snow up over the curb, leaving most of it in the gutters.

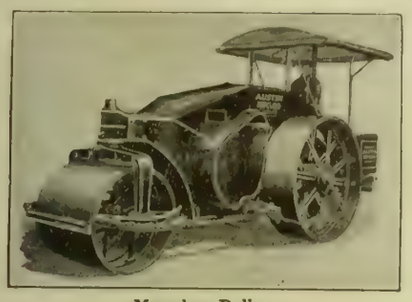
No matter how well a working force may be organized, it seems that at times, as in emergencies for instance, previously made plans will not work out to perfection. Sometimes we get caught by sleet storms, which cover the drives with frozen slush and ice, leaving them in a bad and dangerous condition. After one such storm last winter considerable slush was frozen on one section of driveway which we had been unable to finish cleaning before it froze. The next day the ice was picked loose and hauled to the dump. When using laborers it was found that it required four men with picks to loosen enough to keep a team busy hauling it away. We soon learned that a tractor pulling a road grader worked very well on the frozen slush and ice and with this combination enough was loosened in one hour to keep seven teams busy four hours.

In addition to plowing or sweeping, the tractors with plow and broom attachments removed have been repeatedly used to good advantage in hauling wagons loaded with snow from the downtown district to the dump. For one of the tractors an especially large wagon holding fourteen cubic yards, water measure, was built and the tractor had no trouble handling it. A special device fitted to this wagon enabled the tractor to dump out the fourteen yards of snow in a few seconds.

I have for some time thought of disposing of the snow on the downtown boulevards through the sewers so as to eliminate the expense of taking it to the dump, so last winter a device consisting of a water turbine armed with three free blades and mounted in a wire cage or basket of a size to permit it to be set in a sewer manhole was made and tried out. The water turbine was connected with a fire hydrant, the stream of water revolving the turbine and then flowing through the wire basket into the sewer. The free blades on the turbine agitated the snow shoveled into the basket and mixed it with the water which carried it on through the sewer. With a pressure of fifteen to twenty-five pounds the machine disposed of all the snow that two men could shovel into the wire basket, and with a higher pressure it should take care of all that four men can shovel into it.

Granulated rock salt sprinkled over the drives has also been used for removing snow. There have been some complaints, however, against its use on the park and boulevard drives, the chief objections being that it has a tendency to melt the snow and form puddles of water which is splashed upon automobile bodies, where it forms white spots when dry, due to the salt

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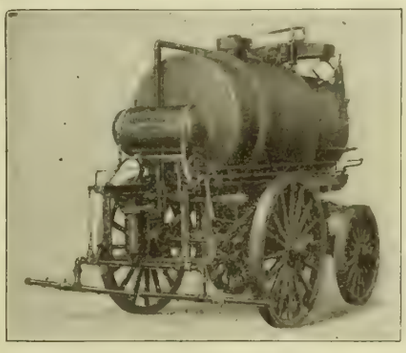
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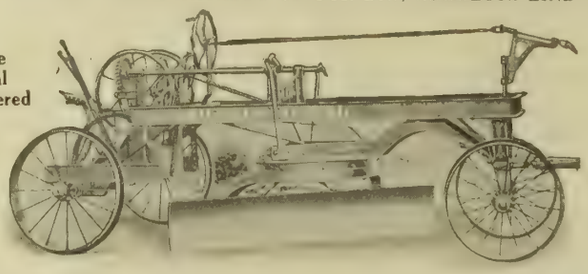
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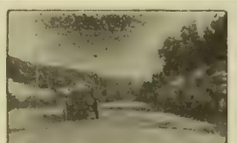
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dissolved in the water; also, that it is tracked into stores and houses, soiling floors and carpets. For this reason we have had to use it sparingly, and then usually to "rot" or weaken the icy coatings formed after sleet storms or on densely compacted snow and ice, so that snow-plows or graders would be able to rip such coatings loose from the pavements. Immediately after sleet storms walks and drives are made safe for travel until the snow cleaning machinery can remove the ice, by spreading torpedo sand lightly over them from specially designed wagons and carts.

The problems connected with snow removal and disposal are becoming of more and more importance every year and merit considerable attention, but it will undoubtedly be some years before machinery and methods are perfected which will enable us to meet all the requirements in a practical, efficient, and economical manner. Until then every contribution towards the solution of these problems will be heartily welcomed by those who realize the importance of snow cleaning work in our large cities.

* * *

## Abstract of the Prescribed Rules of the Office of Public Roads and Rural Engineering for Road Construction under Federal Aid Appropriation

(*Continued from page* 14)

CONTRACTS.

No part of the federal money set aside on account of any project shall be paid until it has been shown to the satisfaction of the Secretary of Agriculture that adequate means, either by advertising or otherwise, were employed prior to the beginning of actual construction, to insure the economical and the practical expenditure of such money.

Bids in every case shall be in such form that all the unit prices will be clearly shown thereon.

A copy of the tabulated bid prices, showing both the unit prices and the total amount of each bid for every individual project shall be furnished promptly to the Office of Public Roads and Rural Engineering.

In advance of the acceptance of any bid, sufficient and ample notice of the time and place of the proposed awarding of the contract shall be given to the Office of Public Roads and Rural Engineering to enable that Office, should it so desire, to have a representative present at the opening of bids. When a bid has been accepted, prompt notice thereof shall be given to the Office of Public Roads and Rural Engineering.

If the contract should, in any case, be awarded to any other than the lowest responsible bidder, the Federal Government shall not pay more than its pro rata share of the lowest responsible bid, unless it is satisfactorily shown that it was advantageous in that particular case to the work to accept the bid of the higher bidder.

CONSTRUCTION WORK AND LABOR.

Unless it shall otherwise be stipulated in writing, materials for the construction of any project, prior to their use, be tested for conformity with the specifications, according to the methods that are approved by the Office of Public Roads and Rural Engineering.

Unless otherwise specifically stipulated in the project agreement, bridges, viaducts, and under-passes shall have clear width of roadway of not less than sixteen feet, and clear head room of not less than fourteen feet for a width of eight feet at the center.

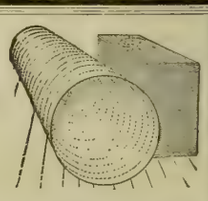
No part of the money apportioned under the Federal Aid Act shall be used, directly or indirectly, to pay, or to reimburse

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a State, county or local sub-division for the payment of any premium or royalty on any patented or proprietary material, specification or process, or type of construction, unless purchased or obtained on actual competitive bidding at the same time or at a less cost than unpatented articles or methods equally suitable for the same purpose.

Written notice of the commencement and the completion of construction work on any project shall, in all cases, be given promptly by the State Highway Department to the Office of Public Roads and Rural Engineering.

Reports of progress, showing the force employed and the work that has been done, shall be furnished whenever requested by the Secretary of Agriculture or his authorized representative or representatives.

RECORDS AND COST KEEPING.

A separate account for each individual project shall be so kept by the State Highway Department as to enable the Secretary of Agriculture to ascertain at any time the expenditures on and the liabilities against the project and, separately, the condition of the ten per cent. fund.

Such other records of contract and force account work, and of the inspections and tests by the State, shall be kept by the State Highway Department as will enable the Secretary of Agriculture at any time to determine the condition of the construction and the maintenance of, and the cost to the State and to the Federal Government of, the construction work and the labor done on any project.

The accounts and records, together with all supporting documents, shall be open, at all times, to the inspection of the Secretary of Agriculture or his authorized representative, and copies thereof shall be furnished the latter when requested.

Certified copies of payrolls on force account work, and of all vouchers for other expenditures shall be furnished whenever requested by the Secretary of Agriculture or his authorized representative.

Whenever requested by the Secretary of Agriculture or his authorized representative, unit costs on any project shall be kept, on forms furnished for that purpose by the Office of Public Roads and Rural Engineering.

PAYMENT.

Vouchers, in the form provided by the Secretary of Agriculture and therein prescribed, showing the amounts expended on any project and the amount claimed to be due from the Federal Government on account thereof, shall be submitted by the State Highway Department to the Office of Public Roads and Rural Engineering, either after the completion of construction of the project or, if the Secretary of Agriculture has determined to make payments as the construction progresses, at intervals of not less than one month.

* * *

## Dual-Purpose Trucks

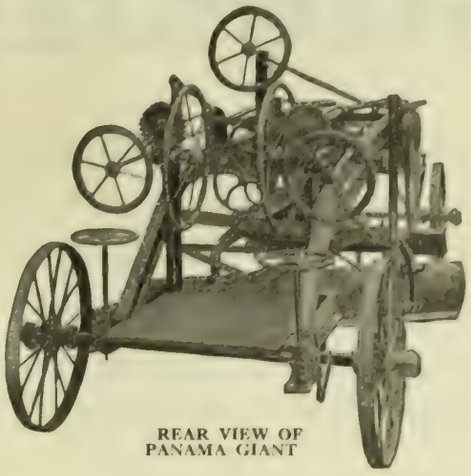
By R. W. Hutchinson, Jr.

THE Callaway Fuel Company, of Milwaukee, uses a Sterling three and one-half-ton truck in retail coal business in the following manner:

The truck after being loaded from overhead hoppers proceeds with its load of helpers to the consumer's premises. It may happen that the consumer may be a private residence having need for only 500 to 1,000 pounds of fuel. In this case, the heavy canvas bags of 100 pounds capacity are loaded with the required amount and delivered through the flour bin type of chute at the rear end of the body, the hydraulic hoist tilting the dumping body sufficiently for the fuel to flow gently. In the event that a bulk load is to be delivered, the large canvas is spread upon the pavement in front of the residence or business premises, the entire load dumping in a heap and the truck immediately proceeds to return to the loading point, the helpers being left behind to put the coal in the premises. In case of a concentrated business district where there is a side or rear alley or even a street not congested by traffic and a number of deliveries are made in the same neighborhood, the helpers may after putting in the coal, walk to the next place of delivery, the address of which has been given them by the driver with the routing card.

It is not always practical to so route the loads as not to detour considerable mileage each day to pick up the helpers.


The "Panama Line"



REAR VIEW OF PANAMA GIANT

The "Panama Line" for 1917 will be The Most Complete in Existence

PANAMA LINE ROAD MACHINERY

OUR announcement of the "Panama Line" for 1917, soon to be made, will find several new machines in the assortment, every one embodying the essential features which have established the high standing of this line.

There will be a machine at 2200 pounds, one at 1700 pounds and still another at 1100 pounds, all of which will have roller bearing wheels and lateral and angular shifting mechanism, heretofore not obtainable in machines of this size. No argument is needed as to the merit of these features, and every contractor and road official knows that by being able to obtain machines incorporating these features they will satisfy a long felt want and be able to accomplish far greater results at less expense.

But these will not be all the new and interesting subjects in the "Panama Line" for 1917. Space will not permit description of the complete line, but we want to send all the facts to every road contractor and official in the country. To be assured of receiving an early copy of this literature, send the attached coupon today.

Get the Facts

MAIL OR USE FOR MEMORANDUM

Send me facts about the Panama Line for 1917.

Name.....

Address.....

City.....

THE F. B. ZIEG MFG. COMPANY
Fredericktown, Ohio

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An Improved Asphaltic Concrete Pavement made by special process.

Especially adaptable for communities where slag abounds.

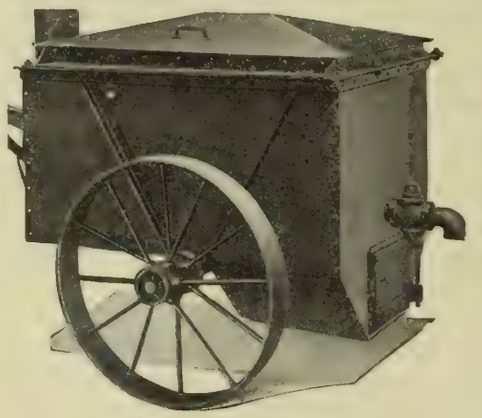
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**The Bitoslag Paving Company**

**90 West Street, New York, N. Y.**



**LITTLEFORD REPAIR AND MAINTENANCE HEATER No. 69**



**(Proof of the Heater is in the Heating)**

This heater has been designed especially for the purpose of heating small quantities of tar and asphalt in connection with repair and maintenance work on streets and roads. Its compact design and durable construction without doubt make it the most efficient on the market.

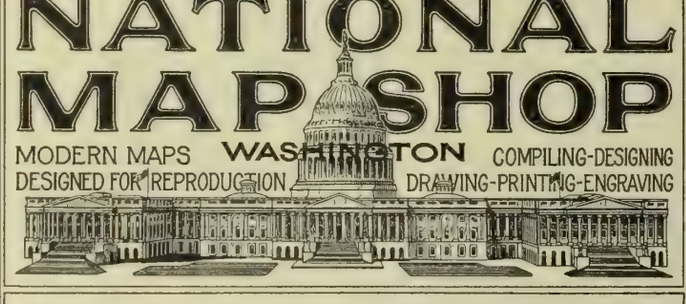
**LITTLEFORD BROS.**

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This especially is true of deliveries in residential districts since one customer may be delivered a load two or three miles distant from the next, necessitating either the helpers proceeding by street car to the next home or the truck detouring to pick them up.

The non-productive time in the operation of picking up the helpers is less than under the horse wagon system and the crude system of some motor coal truck users who keep the truck standing while the helpers are taking off the load and in this way hardly fifty per cent. of the operating day is productive.




As the motoring of the coal handling business is scarcely begun, one of the most inviting fields for the contractor is the hiring of his trucks to coal merchants whose busy season begins to advance as the contractors' recedes. The picture of the seven-ton Sterling truck owned by Anderson Brothers, haulage contractors of Cincinnati, Ohio, is an excellent illustration of a dual-purpose motor truck. During the spring and summer, Anderson Brothers haul sand and gravel, brick and stone for the material dealers of their city. Instead of laying up their relatively expensive piece of efficiency equipment idle during the winter season, they lease it to the coal merchants and keep it going all the year round.

Anderson Brothers' seven-ton Sterling is a combination of double deck or convertible automatic dumping truck. The body is constructed in two sections longitudinally, the capacity of the lower section being proportioned so as to handle a full




load of sand and crushed stone or builders' materials. The flanges of the body are drilled to receive the upper section end by bolting the two decks together, the capacity is sufficient to handle seven tons of soft coal with a reasonable margin for overloading by crowning. The demounting of the upper deck can be accomplished with no more tools than a stout wrench and an overhead crane in less than fifteen minutes time.

The upper section contains hinged steel dividing plates so that when used for coal handling, the truck becomes a compartment body machine so that if the coal dealer renter sells mainly to retailers, tonnages of three and one-half fractional amounts can be delivered independently.

It is of course readily practicable to design the upper deck of such dimensions as will enable the combination of the two




*Illustrating Our Sign in Use on the Cluster Light Standard in Front of City Hall, of Columbus, Ohio*

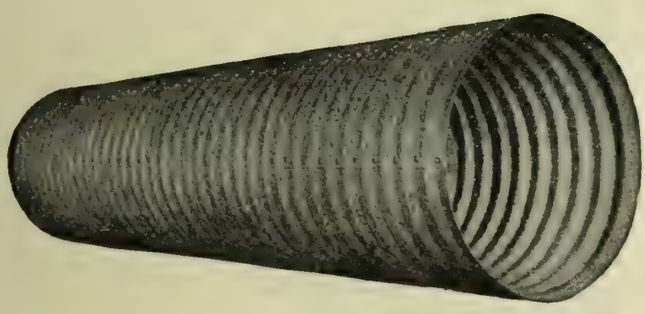
OUR GUARANTEE

A sign, the legibility of which cannot be destroyed by the most severe bending or striking test. A sign that is guaranteed against the cracking or breaking or deterioration from rust for a term of thirty years, on which the lettering never needs renewing. A sign on which the surface coating of the lettering and the surface finish of the plate may be renewed without removing the sign from the standard. A sign which can be refinished and made as good as new at any time at a cost not exceeding 20 per cent. of the original purchase price.

*Send for Our Booklet and Testimonials*

**The Indestructible Sign Co.**

61½ Prescott Avenue COLUMBUS, OHIO



**WHEELING ONE PIECE METAL CULVERTS**

*Made of Portsmouth Iron*

Measured by the strict rules of performance—another good interpretation of service—they are found even better than we claim them to be. We put so much into them you are bound to get more out of them. Write for prices.

WHEELING CORRUGATING COMPANY, WHEELING, W. VA.

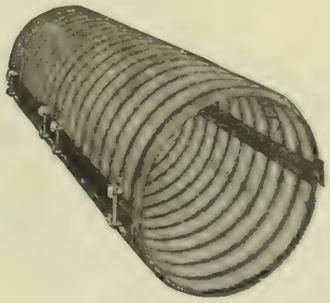
BRANCH OFFICES AND STORES

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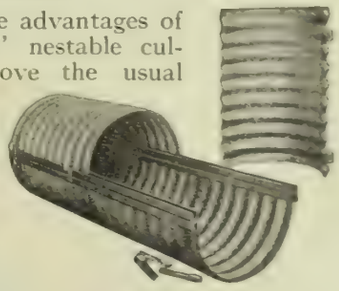
**Performance is the one Judge of Efficiency!**



**"CORCO" Channel Nestable Culverts**

(PATENTED)

Afford all the advantages of "knocked-down" nestable culverts and remove the usual difficulties in the assembling operations. They are simple in design and therefore simple to set up on the job.



# SAVE TIME—SAVE MONEY

**USE THE**

## Burch Expansion Cast Iron Culvert Pipe



**8 to 48 inches diameter, 3 and 4 ft. lengths. Half sections which lock with lugs.**

**Provides for expansion and contraction. Easy to handle and lay in ditch. Requires less excavation. Strong and durable. Send for Catalog "F" giving full description of complete line.**

## THE BURCH PLOW WORKS CO.

**CRESTLINE, OHIO**



# Mogul and Titan Tractors Operate on Kerosene and Other Low-Priced Fuels



Years ago the makers of Mogul and Titan tractors realized that if there was to be cheap power for building roads, it must come from the lower priced fuels—not from gasoline. Accordingly, the keenest inventive minds and the best skill obtainable were put to the task of designing tractors that would use kerosene as well as or better than other tractors operate on gasoline and at the same time do the most reliable work. The Mogul and Titan kerosene tractors are the successful result as experienced road commissioners and contractors know.

That is why you will find in every section of the country today, wherever highways are being bettered, International Harvester tractors in the following sizes, rendering uniform lasting good service: MOGUL 8-16 H.P., TITAN 10-20 H.P., MOGUL 12-25 H.P., TITAN 15-30 H.P., and TITAN 30-60 H.P.

Possibly your road maintenance costs are higher than they need be. Perhaps a little investigation would pay. Would you like to see some of the figures we have collected—some of the savings we have helped other contractors and road builders to make by changing over to Mogul or Titan kerosene tractor power? They'll cost you nothing but a two-cent stamp and a little time. Write for them.

## International Harvester Company of America

(Incorporated)

152 Harvester Building CHICAGO U S A


TELL 'EM YOU SAW IT HERE.

decks to handle anthracite coal and a variety of other bulky materials which the haulage contractor may lease his trucks to transport, such as shavings, saw-dust, etc.

While the possibilities of mounting the dumping body on a platform bed with stake holders for converting it into a mercantile truck at the end of the contracting season are large, very few have adopted the idea.

* * *

## Dynamite is More Useful than Ornamental

Dynamite can now be called the farmer's extra hired man. There was a time when farmers were distinctly distrustful of this kind of hired man, but after fuller acquaintance the progressive ones put him on their pay roll. Road builders have also found that dynamite is an exceedingly efficient assistant, one that doesn't lay off after every pay day, one that doesn't get drunk and one that doesn't lose "his" temper except after great provocation.

The farmer, at first, was willing to admit that dynamite might be useful for removing boulders and stumps, and later allowed that it could dig ditches, plow ground, dig holes for planting trees, drain swampy spots, and break up impermeable sub-soil. Having dynamite around for these purposes, he found it was useful in a number of other ways, and there are many farmers to-day, who will not admit that dynamite has any limits to its sphere of usefulness around the farm.

Road builders also have known for years that it is necessary for making rock cuts and blasting rock ledges for crushers, but many of them to-day do not consider it worth while to have any dynamite around, unless they are working in solid rock. However, it is the purpose of this article to point out a few other places where dynamite may be used to advantage by road builders.

In going through a cut in light soil it helps in loosening up the dirt if charges of a half cartridge of twenty per cent. Red Cross are fired in holes to the required depth, five or six feet apart, each way. Then the scrapers can handle it with ease, doing away with a great amount of hand picking and shoveling. In a hard clay soil, charges of one to two cartridges of twenty per cent. dynamite may be used in holes four to six feet deep, and spaced about six feet apart, and will be found satisfactory for loosening the soil for the scrapers.

Out-crops of rock are frequently met with in road construction, and, of course, require to be drilled either by hand or machine drill for the economical use of explosives. Where it is not possible to drill these out-crops, they may sometimes be mudcapped but this takes several times as much dynamite to do the work under most favorable conditions as compared with that required in a drill hole, and, frequently, is absolutely impractical. Boulders may sometimes be blasted by firing charges in holes driven beneath them with a bar, or they may be drilled and fired, or, if very hard and brittle, it is most economical to mudcap them.

Stumps may be taken out economically and quickly by firing charges of dynamite under them, placed far enough below the surface of the ground so that the crater produced will include the greatest proportion of the roots. Put the charge in the earth under the stump, rather than in the wood itself, except that with stumps having large tap roots; the explosive should be placed either directly in the tap root or on either side of it and about two feet beneath the surface of the ground. Do not try to mudcap the stump, or to get the explosive down into the center of a rotten stump. This splits and spreads it apart; but makes the final extraction of the roots a difficult problem.

Ditching is frequently necessary and may be done in two ways, depending on the character of the soil. In a dry, sandy soil, single cartridges, one and one-fourth inches by eight inches of dynamite are placed in holes two or three feet apart and two to two and one-half feet deep, with an electric Blasting Cap in each hole and the entire line connected up in a series and fired with a blasting machine. In very wet, heavy soil or swampy muck, the ditch may be made by firing charges of one cartridge of fifty per cent. straight dynamite in each hole spaced eighteen inches apart and two to two and one-half feet deep. In this case, it is not necessary to use an electric blasting cap for each hole. One extra cartridge placed in a hole

near the center of the line of holes and fired by either electric blasting cap or a blasting cap will detonate the entire line by influence. Ditches have been dug over a thousand feet long by this method. A hand dug ditch usually costs just about twice as much as a dynamited ditch.

Sink holes, mud holes, bog and miry spots in low lying portions of country roads are often effectually and permanently drained by firing charges of dynamite in holes driven into the impervious stratum of soil, usually clay or hard-pan which forms the basin and prevents the water from running down into the earth. These charges should be fired fifteen or twenty feet apart each way, the depth depending upon the nature of the soil. Wet spots in roads have been permanently cured at very little expense by this method.

Dynamite is one of the handiest and most reliable helps the road builder can have in his equipment. It can be used for felling trees, making post holes for fences or planting trees, and for digging and loosening up the soil for telegraph and telephone pole holes.

Road builders as yet have not exhausted the possibilities of its usefulness, but those who have carried it in stock and used it intelligently, would no more dispense with it in any operation than they would with their equipment of picks and shovels.

* * *

## Will Photograph the United States

To make motion pictures of the whole United States is the job A. L. Westgard, who has traveled more miles of roads in an automobile than any living man, has now set himself.

Thousands of reels of film have been exposed on "scenics" the country over, but hitherto no comprehensive plan of picturing everything worth picturing has been followed. Mr. Westgard, who knows the beauty spots as no other man knows them, believes that he can show Americans things about their own country of which they scarcely dream.

The Pathe Company, which will distribute the films, believes so, too, and so does the Combitone Picture Company, which is financing the expedition. The pictures are to be entirely different from any hitherto seen because made by the new Combitone process, invented and perfected by F. W. Hochstetter, formerly of the Edison staff, now consulting photo chemist of the American Photo Chemical Company.

INTERIOR DEPARTMENT CO-OPERATES.

The automobile motion picture tour, which is to extend for more than 25,000 miles, takes more than a year and includes every State in the Union, is made under the auspices of the National Highways Association, of which great organization Mr. Westgard is Director of Transcontinental Highways, and with the co-operation of the Interior Department, which has arranged for Mr. Westgard to take all the pictures he wants in any and all government reservations, national monuments, national parks, and forest reserves.

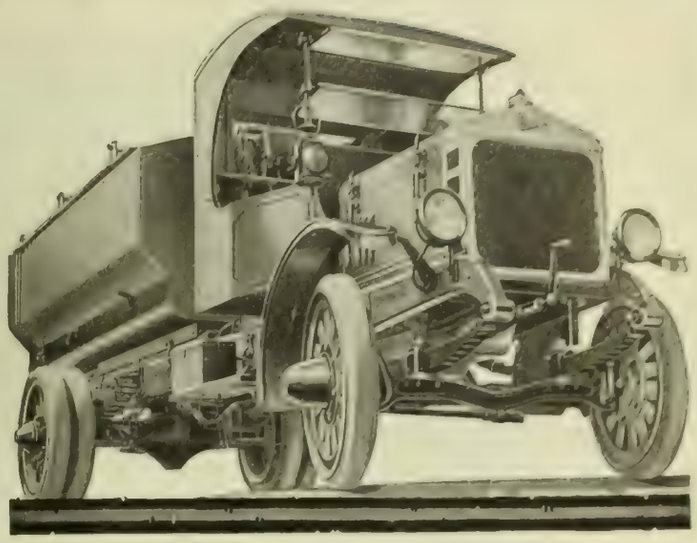
Starting October 20 from Trinidad, Colorado, Mr. Westgard will pilot his two big Paige-Detroit automobiles southward, staying in the warm countries during the winter months. He will not only point his lenses at the well-known scenic beauties, such as the Garden of the Gods, Grand Canyon, Petrified Forest, etc., but upon thousands of scenes, industries, and natural curiosities that the general traveling public knows little about. Having crossed the continent eleven times in automobiles by every available route and gone north and south from the Gulf and Mexican border to the Canadian line by the same means more times than he can count, Mr. Westgard is in possession of unique information regarding roads, views, natural wonders, and the like to enable him to find and photograph many scenes never before pictured.

* * *

We have SEVERAL GOOD POSITIONS open in different sections of the country for COMPETENT ROAD MACHINERY SALESMEN, permanent places on STRAIGHT SALARY AND EXPENSE or SALARY AND COMMISSION. THE AUSTIN-WESTERN ROAD MACHINERY CO., CHICAGO.

* * *

"Laboratory Manual of Bituminous Materials" is the title of a most interesting work by Prevost Hubbard, Chemical Engineer, Chief, Division of Road Material Tests and Research,



Sterling Trucks
Masters of the Road

Like trunk line compound locomotives, Sterling Trucks are built for strength, pulling power and stamina. They are scientifically engineered, massively built, properly proportioned, with strength where strength is needed and without excess weight.

Sterling Trucks are more profitable to operate because they will stand rougher usage—take more knocks and bumps and require less attention. They're built for the ordinary driver to handle—as simple as a truck can be, with all complicated mechanism eliminated.

Sizes 2½, 3½, 5 and 7 tons.

WRITE FOR CATALOG AND FIGURES SHOWING ECONOMIES OF MOTOR TRUCK OPERATION

Sterling Motor Truck Co.
BUILDERS OF MOTOR TRUCKS EXCLUSIVELY FOR NINE YEARS
813 ROGERS STREET MILWAUKEE, WIS.




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MAKE EVERY DAY

**A Blasting Day**

Every road building contractor realizes the importance of his blasting crews using explosives insensitive to frost.

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**Low Freezing Powders**

rarely freeze in cold weather and can be loaded and fired with as satisfactory results as are obtained in warmer weather.

Safeguard your blasting crew, minimize your contractors' risks and extend your outdoor working season by blasting with Red Cross Low Freezing Powders.

***Learn the new ways to make highways.***

Send for FREE Booklet "Road Construction and Maintenance."

**E. I. du Pont de Nemours & Co.**

Powder Makers Since 1802

**Wilmington, Delaware**

**Build Macadam Roads**

The macadam road is gaining favoi each day.

It is the oldest and best class of road construction in Europe and America.

Thousands of dollars are being spent annually to promote Brick and Concrete Roads, BUT BEAR IN MIND THAT A BRICK ROAD COSTS MORE THAN TWICE AS MUCH AS MACADAM and Concrete increases the cost nearly one-half and neither will wear any longer than a high standard Macadam Road.

Figure the total cost of each road covering a period of twenty years or longer and you will adopt macadam.

Get the facts before adopting your specifications.

Write us for information on stone and slag macadam, water-bound, or treated with asphalt or tar.

We can make delivery of crushed stone or slag in all parts of Northern Ohio, Eastern Ohio, Northern Indiana, and Southern Michigan.

**THE FRANCE STONE CO.**

TOLEDO, OHIO

General Office: Second National Bank Bldg.

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Office of Public Roads and Rural Engineering, U. S. Department of Agriculture, just being published by John Wiley and Sons, Inc., New York City, N. Y. For students in Highway Engineering the book is invaluable, while engineers, contractors and officials connected with our highways will find in it a large fund of information and interesting data.

* * *

The Jamestown Shale Paving Brick Company of Jamestown, N. Y., has become a licensee of the Dunn Wire-Cut Lug Brick Company, of Conneaut, Ohio, and will make wire-cut lug paving brick. This company has been making paving brick for more than thirty years and has rebuilt its plants so they are modern, up-to-date and fireproof. It has a daily capacity of 65,000 blocks. It operates five rectangular kilns with a daily capacity of 25,000 and a continuous kiln with daily capacity of 40,000. The company has seventy-five acres of workable shale bed from seventy-five to 100 feet within the city limits of Jamestown.

The officers of the company are: A. N. Broadhead, President; Thomas Mahoney, Vice-President; John Mahoney, Treasurer; J. B. Fisher, Secretary; R. F. Fisher, Manager; A. B. Green, Superintendent.

* * *

The Cleveland Brick & Clay Company, of Cleveland, Ohio, has been added to the list of licensees of the Dunn Wire-Cut Lug Brick Company, of Conneaut, Ohio, and henceforth will make wire-cut lug paving brick. The company is one of the most prominent paving brick manufacturing concerns in northern Ohio and it has a daily productive capacity of 60,000 blocks. J. L. Higley is president of the company, and A. A. Hendershot is secretary.

* * *

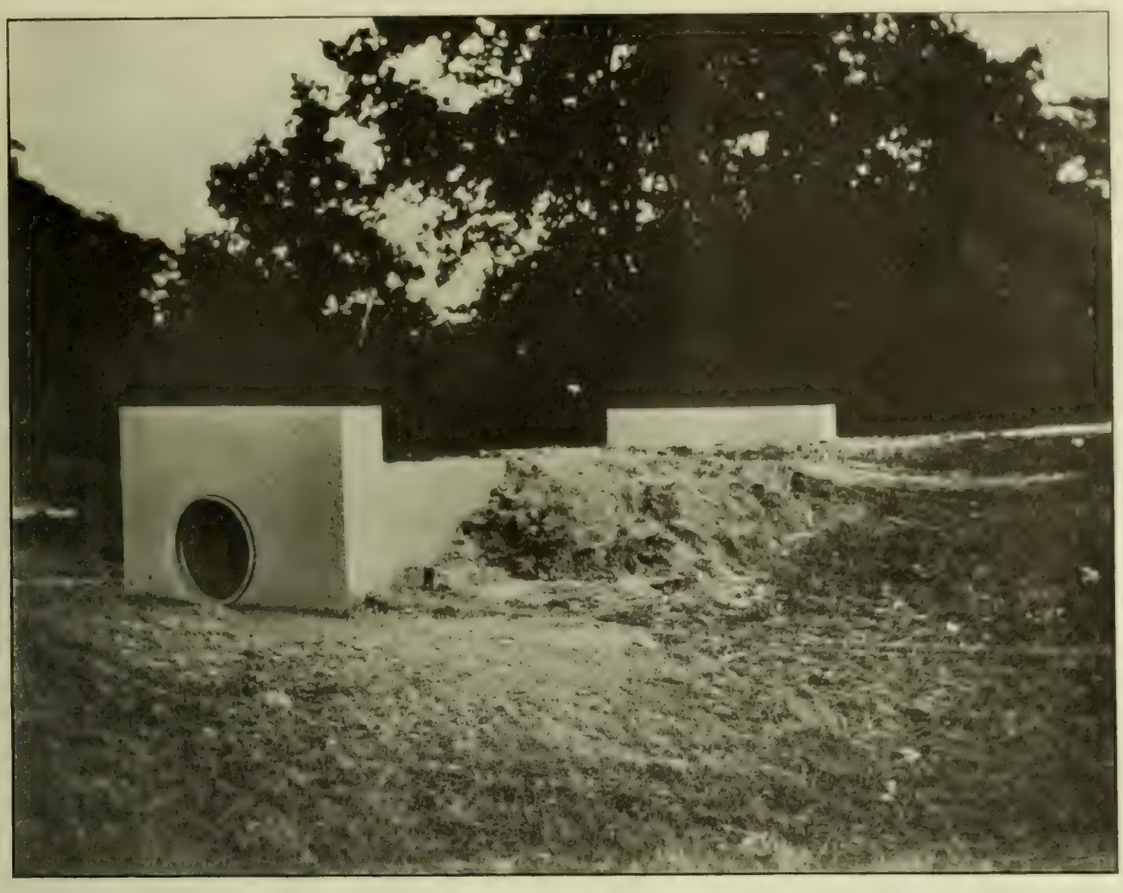
Fifteen million dollars for the completion of the State highway system is available in California as a result of the election. Overwhelming endorsement of the big bond issue was given, insuring the paving of approximately 1,000 miles of road in addition to the 1,122 miles already finished at an expense of $16,000,000.

Initial work will be done on the trunk lines extending from San Diego to the northern boundary of the State. One-fifth of the sum voted will be devoted to the construction of new highways among which will be one north from Los Angeles into the famed Sequcia forests. These giant trees are said to be the oldest living things in the world and will be the terminus of a highway expected to surpass all others in California in scenic beauty.

In addition to the State funds California has available immediately more than $250,000 from the federal State road fund, this State having been first to obtain federal aid under the new government rural road act. Work also will begin at once sign posting the Mojave desert over which crosses the only open-all-the-year-round highway from the East to California. The government appropriated funds for posting the water holes only after a battle extending over fourteen years had been waged by the Los Angeles Chamber of Commerce, to make traveling over this highway absolutely safe for strangers.

* * *

This has been an excellent summer and fall for the Erie steam shovel on road work. The Ball Engine Company, Erie, Pennsylvania, manufacturers of this shovel, are not preparing to "call it a season," as is so often the case at this time of the year, the reason being that there are still many orders coming in for shipment of these shovels to the South and even in several cases in the North, where road contractors will take advantage of the better labor conditions to do heavy work on road contracts that they have been awarded during the late fall. Some fine reports have been received regarding the accomplishments of this shovel, but it is doubtful if any "Erie" performances are better than that observed by one of the editors of Better Roads and Streets a short time ago. In this particular case, the three-quarter-yard "Erie" was working on a rock cut twenty feet deep on the Portage Road Subway at Niagara Falls, N. Y., and it was a common occurrence to see her take out single rocks measuring two and two and one-half cubic yards and then throw them up on the embankment to be broken up and hauled away. This work was being done by the Peckham Construction Company, of Buffalo, of which well known concern H. W. Ellis is treasurer.



*Courtesy of The Ohio Highway Commission*

**A Road Culvert of Concrete Lined With**

# VITRIFIED CLAY SEWER PIPE

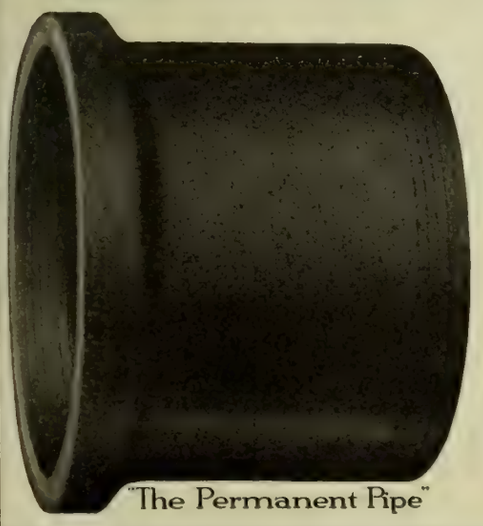
GIVING

## Maximum Service at Minimum Cost

The Sewer Pipe serves a double purpose: First, a form around which the concrete is placed, and second, an indestructible lining for and protection to the concrete walls, proof against acids, sulphur water, rust and decay, with a smooth surface that facilitates the flow of water and sewage.

## Approved by State Highway Commissions

Officials and others interested in securing the most economical and permanent Highway Construction are urged to write us for detailed information concerning this best-of-all material for culverts and side drains. Expert engineering advice furnished on request.

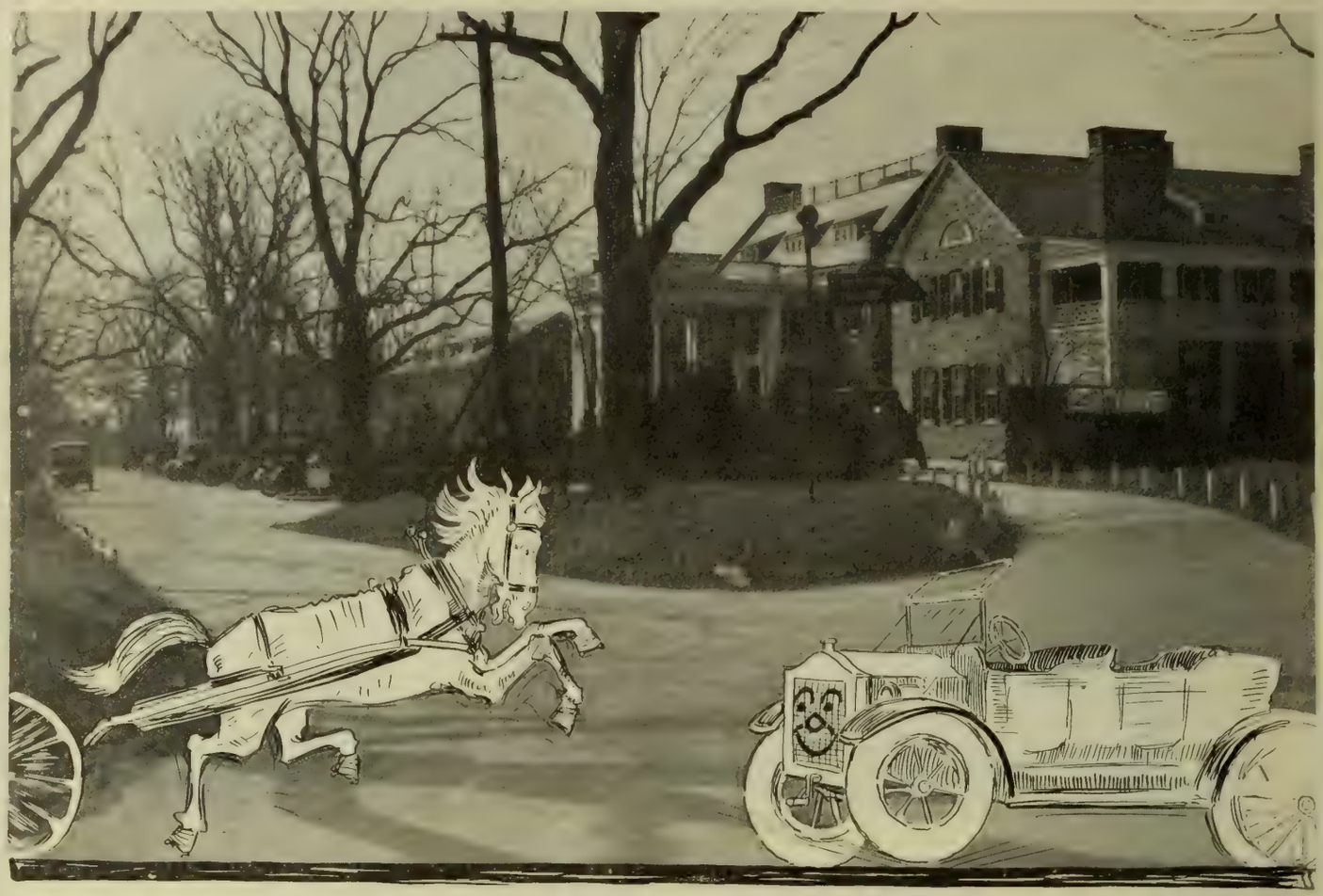





**The Sewer Pipe Mfrs. Association**

*John L. Rice, Field Commissioner*

**Second National Bldg., AKRON, O.**



# BERMUDEZ ROAD ASPHALT

## "IT STAYS PUT"

**Horse:** This is the road of perfection.

**Auto:** The United States Office of Public Roads built it—That's why.

**Horse:** They used Bermudez Road Asphalt which is another reason why.

**Auto:** The President uses it when he goes a'golfing.

**Horse:** Yes, this is one place where he has smooth sailing.

**Auto:** None of the jars or bumps of official life.

**Horse:** The service test road right outside of this club carries 40 TONS of TRAFFIC FOR ONE CENT.

**Auto:** Don't be silly! 40 tons for one cent! You tickle my carburetor!

**Horse:** All right then, Lizzie, look at this table and judge for yourself.

COST PER SQUARE YARD.

| Experiment No. | Trade Names. | Construction Cost | Maintenance Cost to Jan., 1916 | Total Cost to Jan., 1916 | Ton-Miles per 1c of Maintenance to Jan., 1916 |
|---|---|---|---|---|---|
| 1 | Tar | $0.4618 | $0.0221 | $0.4839 | 2.9 |
| 2 | Tar | .6442 | .1549 | .7991 | 16.9 |
| 3 | Bermudez native asphalt | .6469 | .0094 | .6563 | 40.7 |
| 4 | Oil asphalt (G) | .5716 | .0259 | .5975 | 12.3 |
| 5 | Oil asphalt (S) | .5827 | .0290 | .6117 | 16.0 |
| 6 | Oil asphalt (T) | .6822 | .0207 | .7029 | 23.4 |
| 7 | Oil asphalt (A) | .5996 | .0250 | .6246 | 16.5 |

These data show that the Bermudez section of the U. S. Office of Public Roads Chevy Chase Experimental road has carried 40.7 ton miles for every penny spent in maintenance from 1911 to January, 1916. The next best road only carried 23.4 ton miles for each cent of maintenance.

# The Barber Asphalt Paving Co.

PHILADELPHIA, PA.

# For Highway and Railroad Drainage



## "Armco" Iron Corrugated Culverts

### For Adaptability, Efficiency and Long Service

They are adapted to steam and electric railroads, to rural earth roads and to city boulevards. Their corrugated form and overlapping joints confer ample strength together with a resiliency or **toughness** which enables them to stand more grief and hard luck than anything else in the form of a culvert. And their material is the **purest,** most **even** and most **durable** of irons.

AMERICAN ARMCO INGOT IRON
"ARMCO" IRON
the product of The American Rolling Mill Co. is the standard for Purity and Rust-Resistance

For full information on "Armco" (American Ingot) Iron Culverts, Siphons, Flumes, Sheets, Roofing and Formed Products, write to

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**Cincinnati, Ohio**

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## *with*
# STANOLIND PAVING ASPHALT



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The exact information which you need to construct new roads or protect old ones is contained in our free book "Stanolind Paving Asphalt."

Stanolind Paving Asphalt is produced from Mid-Continent Crude under a new patented process, and is furnished in all consistencies suitable for

### Sheet Asphalt - Asphaltic Concrete Asphalt Macadam

Also Seal Coats for Water Bonded Roads.

Other road products of proven efficiency are:—
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## STANDARD OIL COMPANY
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# WARRENITE—The Automobile Highway Surface



Warrenite Hard Surface Roadway on Terwilliger Road in Multnomah County, Portland, Oregon.

Every Municipality Should Surface Their Roads With

# WARRENITE

To Insure Good Permanent Roads

IT IS ACTUAL ECONOMY

to surface your roads with WARRENITE, the country road surface made of varying sizes of stone and bituminous cement, scientifically combined and laid on the road, hot, and compacted with a heavy steam road roller. The road is ready for traffic immediately after rolling.

**WARRENITE**—No waiting for it to set.

**WARRENITE**—Stops chipping and consequent dust.

**WARRENITE**—Stops maintenance expense each year as in Macadam.

**WARRENITE**—Stops automobile skidding and horses slipping.

**STOP AND THINK!**—Other counties are surfacing their Macadam with WARRENITE. Why don't you? Consider how the automobile traffic is increasing each day, and the damage it is doing to the Macadam roads. Then specify WARRENITE and your road problem will be solved and that great maintenance expense eliminated.

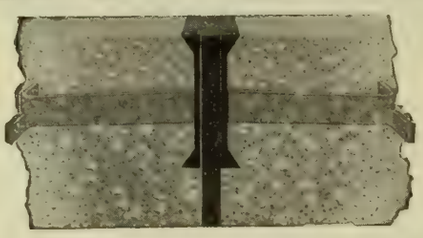
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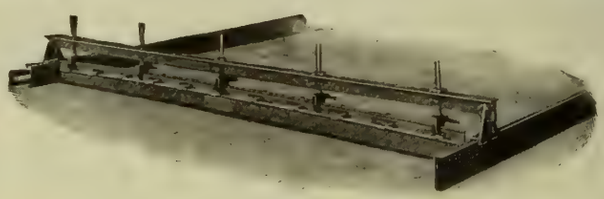
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KAHN ARMOR PLATE



KAHN INSTALLING DEVICE

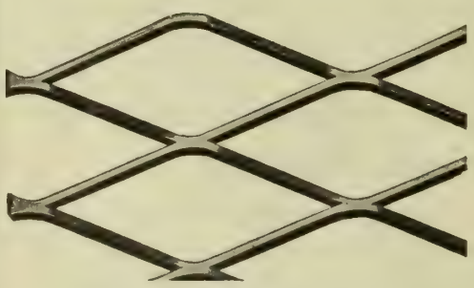
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***Kahn Curb Bar***—protects concrete curbing and provides a reinforcement for the curb itself. Furnished straight or curved. Also Kahn Edge Protector for protection of edges.



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Do not ravel with traffic.

Do not break up by frost.

Forms a hard, compact surface.

Just right for perfect traction
Every month in the year.



Glutrin Bound Macadam Road, Goshen Township, Mahoning County, Ohio

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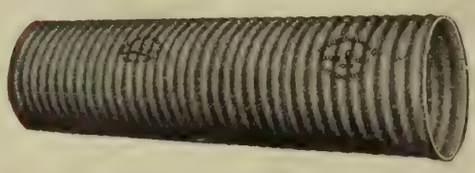
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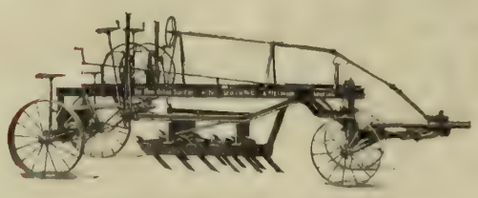
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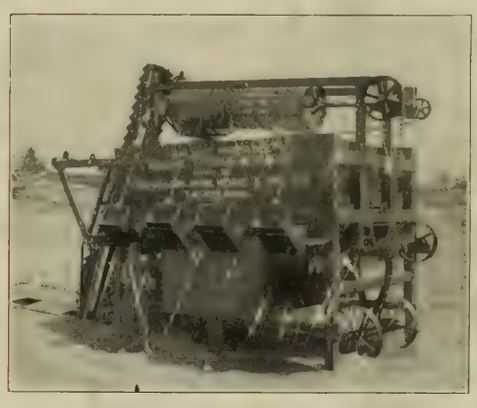
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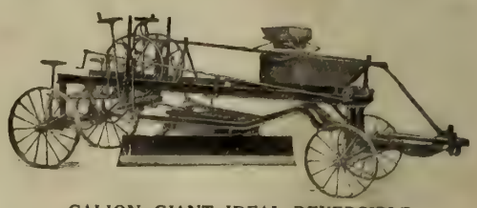
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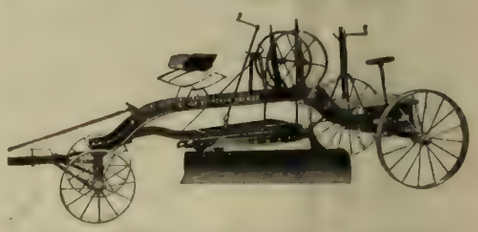
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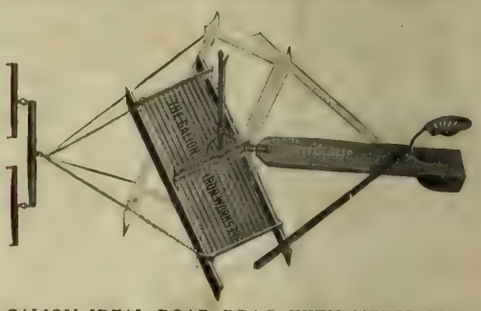
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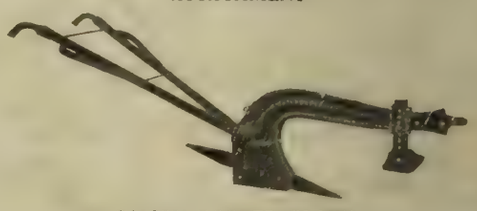
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